# AERONAUTICAL ENGINEERING REVIEW

JANUARY 1948

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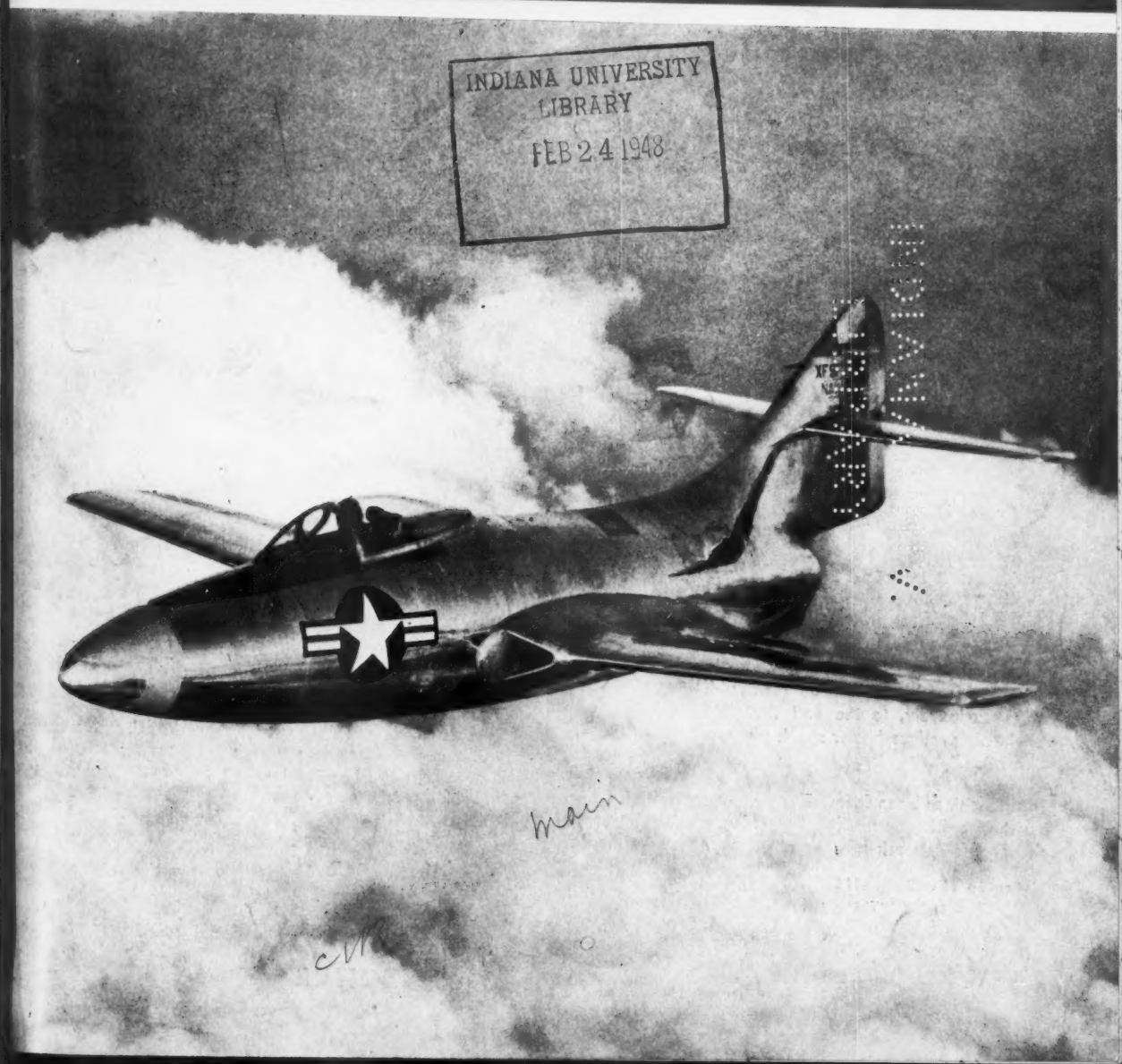

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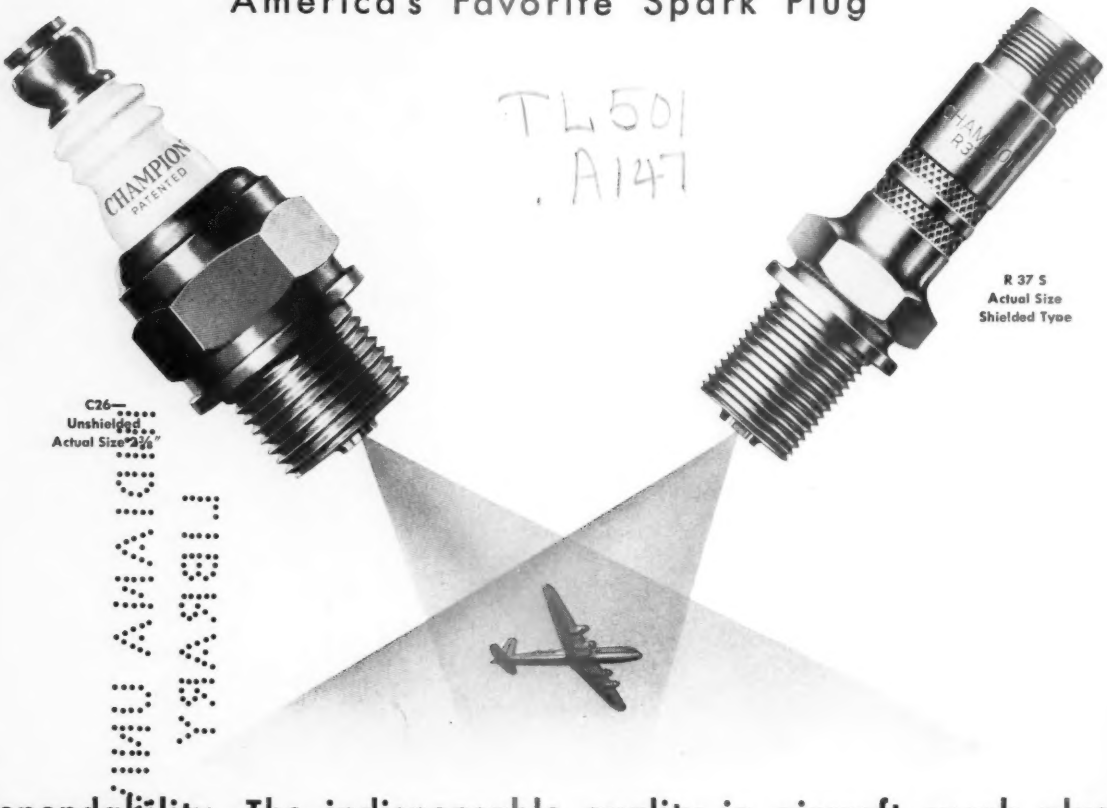


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**CHAMPIONS**
**AND FLY WITH CONFIDENCE**

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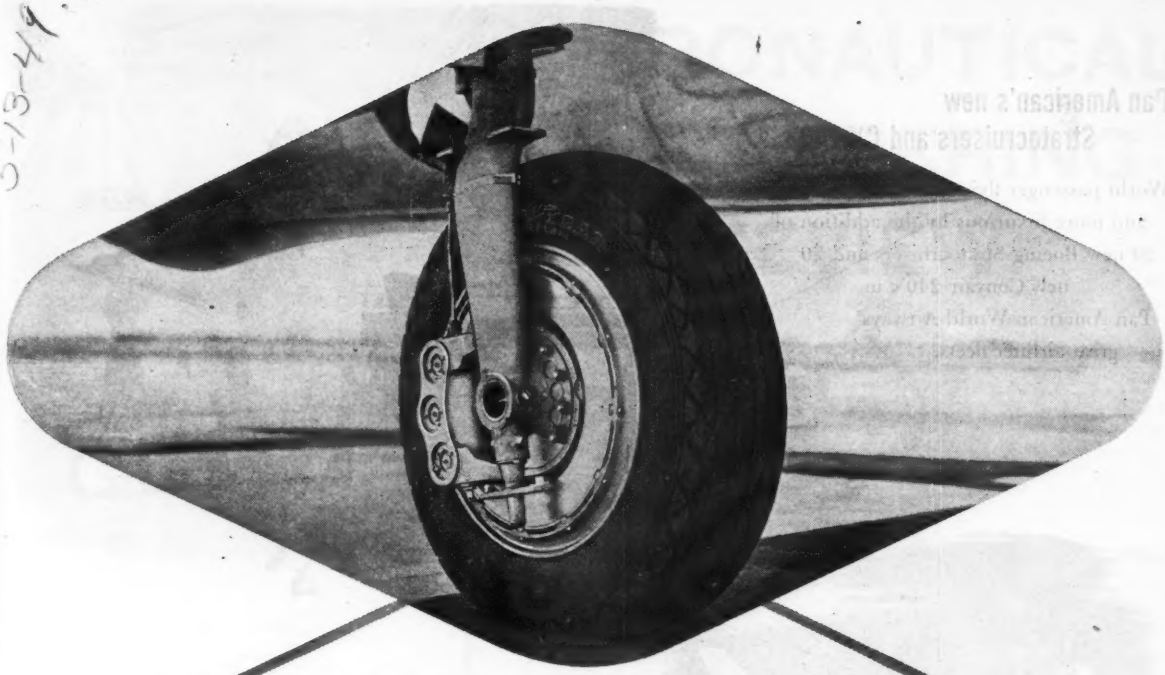

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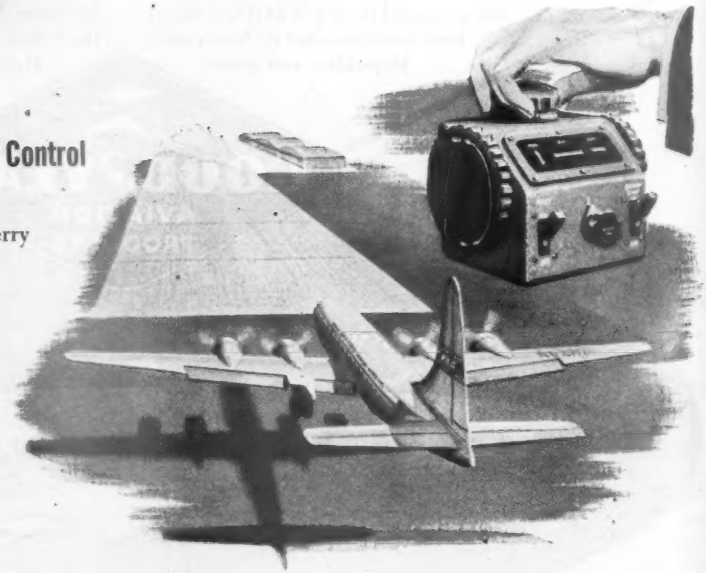

**Sperry Gyroscope Company, Inc.**

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# AERONAUTICAL ENGINEERING REVIEW

Vol. 7 JANUARY, 1948 No. 1

Cover—Newest Navy jet fighter, the Grumman XF9F2 Panther.

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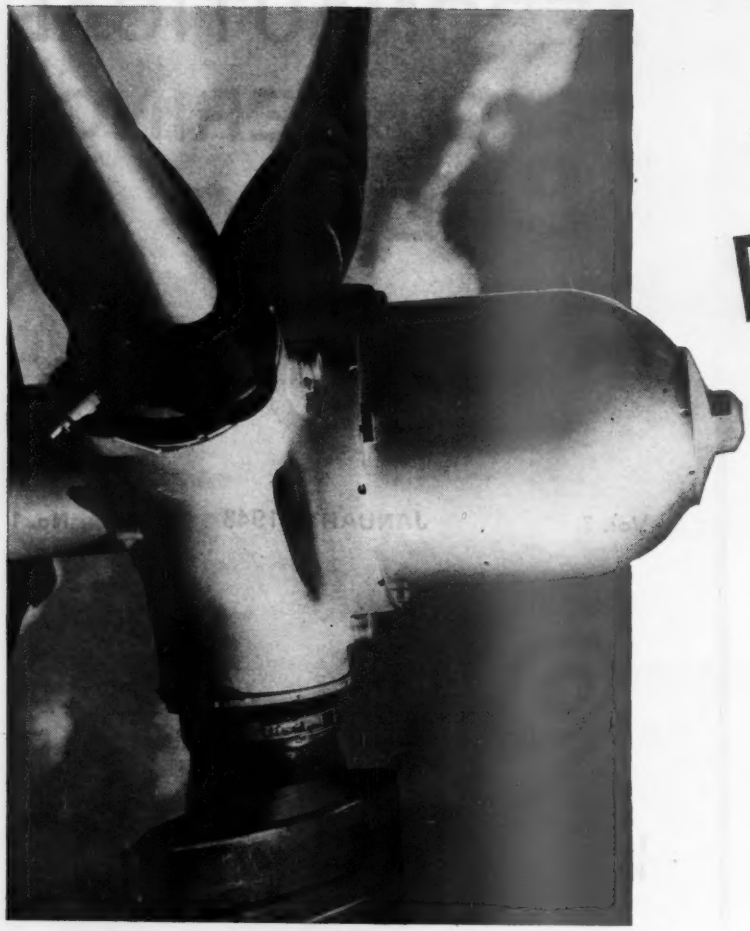

# ONLY DEPENDABLE METALS belong in the air

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Plowing through the air at speeds of from five to nine miles per minute, controllable-pitch propellers must withstand not only high centrifugal stresses, at both normal and sub-zero temperatures, but also high air loads and high vibratory stresses. Furthermore the blade material should be highly resistant to fatigue stresses and to erosion by water, cinders and ice.

To assure these important qualities the engineers of the Hamilton Standard Propellers Division of the United Aircraft Corporation specify Nickel-chromium-molybdenum steel. This steel responds readily to heat treatment to provide a minimum yield strength of 135,000 p.s.i.

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# I.A.S. News

*A Record of People and Events of Interest to Institute Members*


# Northrop President for 1948; Succeeds Preston R. Bassett

## New Vice-Presidents Include C. L. Johnson, Lockheed; Smith de France, N.A.C.A.; R. P. Lansing, Bendix Aviation; Earl Osborn, Edo—Fairchild Elected Treasurer.

JOHN K. NORTHROP, who was elected sixteenth President of the Institute of the Aeronautical Sciences by the I.A.S. Council, will be formally inducted into office during the Annual Meeting at the Hotel Astor in New York City, January 26–29, 1948. The new President, prominently known as President of Northrop Aircraft, Inc., and pioneer of jet-powered all-wing aircraft, succeeds the East's Preston R. Bassett, President of Sperry Gyroscope Company, Inc., in line with I.A.S. policy to elect alternately East and West Coast leaders as President.

In addition to Northrop, the Council elected the new 1948 Vice-Presidents and 1948 Treasurer.

▶ **Other Officers Elected**—The new 1948 Vice-Presidents include: Clarence L. Johnson, Chief Research Engineer, Lockheed Aircraft Corporation; Smith J. de France, Engineer-in-Charge, Ames Aeronautical Laboratory, National Advisory Committee for Aeronautics; R. P. Lansing, Vice-President—Group Executive, Bendix Aviation Corporation; and Earl D. Osborn, President, Edo Corporation.

The 1948 Treasurer is Sherman M. Fairchild, Sherman Fairchild & Associates.

Re-elected were S. Paul Johnston, Director; Bennett H. Horchler, Executive Vice-President; Robert R. Dexter, Secretary; and Joseph J. Maitan, Controller.

▶ **All-Wing Aircraft Pioneer**—Jack Northrop, who designed and built the first practical powered plane of the all-wing type in 1940, delivered the 1947 Wilbur Wright Memorial Lecture in London before the Royal Aeronautical Society, one of the comparatively few Americans invited to do so since inception of the Memorial Lecture in 1913. He chose as his subject "The Development of the All-Wing Aircraft," an ideal toward which he has constantly striven for the past 30 years.

In 1923 Northrop laid down the designs of a glider that incorporated the necessary elements of the ideal, all-wing sustaining surface. In 1929 he designed a flying wing that housed the pilot and power plant within the wing contour but which included a small tail assembly carried on tail booms. This model made numerous flights in 1929 and 1930, affording much valuable data on aerodynamics and structures.

At present, the U.S.A.F. is testing the great YB-49 eight-jet all-wing bomber, which was flown from Northrop Field, Hawthorne, Calif., to Muroc Air Base.

▶ **Northrop Accomplishments**—Starting as an architectural draftsman after his graduation from Santa Barbara High School in 1913, Northrop developed into one of the foremost aircraft designers and manufacturers in the country. His numerous contributions to aeronautics are recognized both at home and abroad.

Among the Northrop accomplishments are the Alpha (1929), which pioneered multicellular metal construction, jumping the useful life of planes from 1,000 or 2,000 flying hours to more than 10,000 hours; the Navy BT-1 dive bomber (forerunner of the Douglas Dauntless); the P-61 Black Widow, claimed to be the first specific night fighter ever designed; and the Northrop Reporter F-15 photoreconnaissance plane.

In addition, Northrop was responsible for the design and development of one of the first successful lightweight boat or seaplane anchors which proved of great value in World War II.

He recently received the American Society of Mechanical Engineers' Spirit of St. Louis Medal, awarded for "meritorious service in the advancement of aeronautics."

**New I.A.S. Head:** *Elected 1948 President of the Institute, John K. Northrop, noted West Coast aircraft designer and manufacturer, takes office this month.*

### I.A.S. Calendar

| | |
|---|---|
| **March 19*** | Flight Propulsion Meeting, Cleveland |
| **July** | Annual Summer Meeting, Los Angeles |

**For details see page 29**

* New date.

# 11th Wright Brothers Paper Called "Masterly Presentation"

## *British Aerodynamicist Emphasizes Wings Specially Designed for Purpose Are Needed for Most Efficient Use of Boundary-Layer Control Principles; Increased Performance Expected from New Suction Airfoil Design*

OPENED BY Preston R. Bassett, 1947 President of the Institute, the Eleventh Wright Brothers Lecture, delivered by Dr. Sydney Goldstein of Great Britain, was held December 17 on the anniversary of the first flight by Wilbur and Orville Wright 44 years previously.

▶**Message to Orville Wright**—In opening the meeting, Mr. Bassett read the following telegram, sent to Orville Wright, regretting that the pioneer was unable to attend:

*"On the occasion of the reading of the Eleventh Wright Brothers Lecture commemorating the Forty-Fourth Anniversary of the first airplane flights made by you and your brother, the Officers and Council of the Institute express their deep regrets that you are unable to be present and extend best wishes for your good health."*

▶**Progressive Influence**—Chairman Dryden, in introducing the 1947 Wright Brothers Lecturer, remarked that "we remember the Wright brothers not by dwelling on the events of the past but rather by striving to bring to pass our hopes for the future" and said the lectures have exerted "a marked influence on the progress of aeronautical research."

To be invited to give the lecture is a highly coveted honor, he added, and serves to stimulate original and creative activity.

Dr. Dryden then introduced Dr. Goldstein, distinguished British aerodynamicist and mathematician, delivering to him the honorarium provided through The Vernon Lynch Fund established by Edmund C. Lynch in honor of his brother.

▶**"Sheep Thrown to Wolves"**—Humorously mentioning that he felt like a "mathematical sheep thrown to the aeronautical engineering wolves," Dr. Goldstein, who is Beyer Professor of Applied Mathematics at the University of Manchester in addition to being Chairman of Britain's Aeronautical Research Council, told his audience of some 600 I.A.S. members and guests: "One thing I can promise you—there won't be a single mathematical formula in the *spoken* lecture."

The paper, "Low-Drag and Suction Airfoils," based upon reports only recently released by the British government, was concerned with the problem of reducing wing drag by means of boundary-layer suction on surfaces of wings with shapes *specially* designed for the purpose, conventional airfoils being entirely inadequate for the most efficient application of suction airfoil principles. (Dr. Goldstein's paper will be published in a future issue of the JOURNAL OF THE AERONAUTICAL SCIENCES.)

Some points made by the British scientist in discussing the principles of the ordinary low-drag wing were:

- Principle underlying the design of low-drag wings is to design to keep as much of the boundary-layer laminar as possible without boundary-layer separation before the trailing edge; transition to turbulence should be as far aft as possible, without any risk of boundary layer separating.
- Mathematical and experimental researches have laid a basis for understanding the instability of laminar boundary layers, but it is clear that this instability is not itself the same thing as, or necessarily leads to, transition in turbulence.

Certain overall experimental results indicate that (1) low-drag wings should be designed so that, at design lift coefficient and over as wide a range of lift coefficients as possible, the velocity outside the boundary layer rises from the front stagnation point to a position as far back along the wing as possible; (2) the larger the unfavorable pressure gradient, the greater the risk of boundary-layer separation.

Describing two series of flight tests, one on a Bell Kingcobra, Dr. Goldstein mentioned the problem posed by the picking up of flies and other insects during take-off and climb.

▶**Flies Increase Drag 50–100 %**—Flies would stick to the surface, he said, generally over the first 10 per cent of the chord; they would disintegrate and be found in the form of small parts of flies' bodies stuck to the surface with a "particularly potent glue." Transition to turbulence was, of course, produced by the resulting "roughness," and the drag was thereby raised by 50–100 per cent.

The problem was serious, and no practical solution has yet been found.

Other points covered in the paper:

- Design of suction airfoils.
- Some experimental results on suction airfoils.
- Suction quantities.
- Effective drags.
- Slot and ducting design.
- Thick suction wings.

In his concluding remarks, Dr. Goldstein said that much is yet unknown about suction wings. It is important to realize, he declared, that suction wings may be designed of any thickness required.

▶**Flying Wing Greatest Gainer**—The greatest gains will be obtained by applications of suction airfoil design to flying wings, he said.

However, the main application must be to transport aircraft because the large thickness necessarily leads to a low critical Mach Number, although the critical speed might be lifted to 450 m.p.h. by use of sweepback.

One problem unanswered by the tests, Dr. Goldstein said, and which must await experiments, is that of safe landing of aircraft if the artificial suction apparatus should fail, although he considered the picture "more cheerful" than would be anticipated by the appearance of the airfoil shapes.

### Wakefield Gold Medal Awarded Link for Trainer

Edwin A. Link, President of Link Aviation Devices, Inc., received the Wakefield Gold Medal of the Royal Aeronautical Society in a ceremony just preceding delivery of the 1947 Wright Brothers Lecture by Dr. Sydney Goldstein at the U.S. Chamber of Commerce Building, December 17.

The Medal, awarded Link for his invention of the Link Trainer, is given annually by the R.Ae.S. to "the designer of any invention or apparatus tending towards safety in flying."

Air Chief Marshal Sir Guy Garrod, senior R.A.F. officer to United Nations, represented the British Ambassador in presenting the Medal to Link.

# Rodert Wins Collier Trophy

**Collier Trophy Winner:** *Lewis A. Rodert, Aeronautical Engineer of National Advisory Committee for Aeronautics, was awarded the 1946 Collier Trophy for his work on aircraft ice prevention.*

The Robert J. Collier Trophy, one of the nation's highest aviation awards, was given to Lewis A. Rodert, Chief of Flight Research, Flight Propulsion Laboratory (Cleveland), National Advisory Committee for Aeronautics, it was announced by the National Aeronautic Association, custodian of the Trophy.

Cited for his "pioneering research and guidance in the development and practical application of a thermal ice-prevention system for aircraft," Rodert, a Member of the Institute of the Aeronautical Sciences, received the award from President Truman, a fellow Missourian, at the White House, Wednesday, December 17.

▸ **1946 Winner**—The feat that caused the Collier Trophy judges to make the 1946 award to Rodert followed nearly 10 years' research in the laboratories and research planes of N.A.C.A., which he directed, culminating in the flight of a twin-engined transport, equipped with "heated wings," which last year flew repeatedly through some of the worst ice storms in the country while other aircraft were grounded.

Calling this "the greatest achievement in aviation in America," the judges chose Mr. Rodert as the winner.

▸ **Ice Hazard Diminished**—Real significance of the work by Rodert and his associates is that ice, one of the most persistent and ominous menaces to dog air navigation, becomes greatly diminished in importance as a flight hazard through the successful development of thermal ice-prevention systems.

All new transport aircraft in this country are now incorporating thermal ice-prevention systems.

Much of Rodert's basic research was conducted at N.A.C.A.'s parent laboratory at Langley Field, Va. Advanced flight research was led by him at the Ames Aeronautical Lab at Moffett Field, Calif., and, in collaboration with the air lines and Air Force, in Minnesota.

▸ **Heat Application to Parts**—Application of heat to ice-vulnerable parts takes many forms, depending on the part.

• **Wings and tail surfaces** are protected by piping hot air, derived either from exhaust heat exchangers or special combustion heaters, through the leading edges—where ice begins to form.

• **Propellers** can be freed of ice by conducting hot gas through the blades, installing electrical heating elements inside the blades or applying electrically heated thin rubber coverings on the blade surface. The latter method can be applied to other vulnerable parts, such as antenna masts and pitot tubes.

• **Engine air intake ducts** and carburetors are protected by heated air.

• **Windshields** are constructed with hot air circulating between two sheets of glass or by a new, specially developed glass that can conduct electricity for heating purposes.

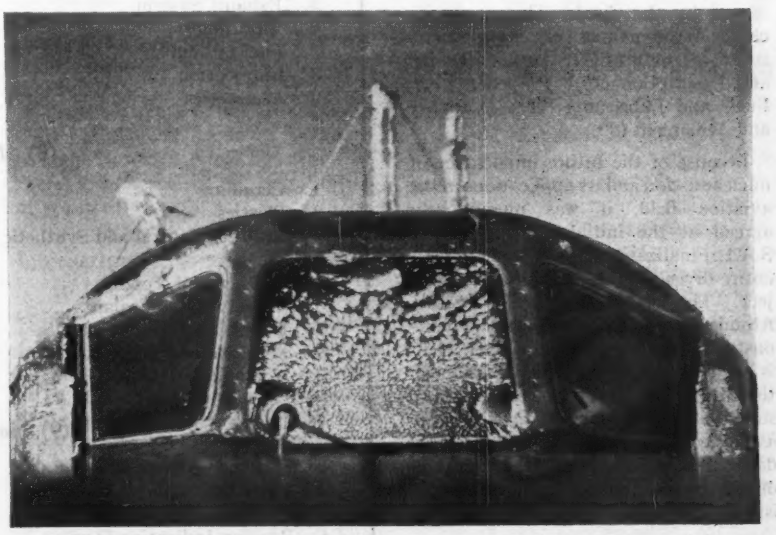
▸ **Improved Reliability**—While the paramount benefit from thermal ice prevention is safety, improved reliability of air-transport service under icing conditions is an important result of the development. Without detracting from the importance of preventing ice from forming on all vulnerable parts of a plane, the "hot wing" probably is the most spectacular application of the thermal ice-prevention idea.

President Truman, in presenting the Trophy to Rodert, had a personal interest in this year's winner not only because Rodert is a native Missourian but also because the President's plane, The Independence, a Douglas DC-6, is one of the first production models utilizing the thermal system.

## 1947 Wright Lecturer Speaks at Univ. of Texas

Dr. Sydney Goldstein, Chairman of Britain's National Aeronautical Council, who delivered the 1947 Wright Brothers Lecture in Washington, D.C., December 17, gave four lectures on aerodynamics at the University of Texas under auspices of the Public Lectures Committee of the University, joined by the Defense Research Laboratory and Department of Aeronautical Engineering, December 18–20.

Subjects of his four talks were: "The Aerodynamics of Transport Aircraft," and "Transonic and Supersonic Flow." The latter formed the subject of three technical lectures for scientific personnel and graduate students, while the first, on transport aircraft, was open to the public.



**Thermal Demonstration:** *Contrast of an unprotected windshield panel (center) with clear, heated panels to either side, demonstrates the effectiveness of thermal ice-prevention system of Lewis A. Rodert (1946 Collier Trophy winner). In addition to windshields, wings, and tail surfaces, propellers and engine air intakes and carburetors can be protected by various applications of heat to ice-vulnerable parts.* (*N.A.C.A. photo.*)

# Six Division Heads of S.A.I. Finalized

Six major divisions of the Standard Aeronautical Index have been subdivided into sections and the new sections have been accepted and are now in use in the dissemination program of the Air Documents Division. To expedite the acceptance of sectional breakdowns of the Standard Aeronautical Index, a Finalization Board was appointed late in December at a meeting at Wright Field. Members of the new board are Lt. Col. Albert A. Arnhym, Chief, Air Documents Division, Chairman; Ernest W. Robischon, Technical Consultant to Air Documents Division and Project Officer for the contract; and Leslie E. Neville, Director, S.A.I. Ned M. Thorne, Dayton representative of the S.A.I., will serve as secretary of the board.

The six divisions for which Section headings are now accepted are: Guided Missiles (1); Power Plants, Rocket (4); Power Plants, Jet and Turbine (5); Power Plants, Reciprocating (6); Materials (8) and Instruments (9). Section headings, determined for these divisions on the basis of widespread consultation with specialists by members of the S.A.I. staff, are shown in the box.

The new board will select at intervals the divisions most urgently needed because of the accumulation of documents at the A.D.D., and the S.A.I. will concentrate on the coordination of section headings for these divisions according to a predetermined schedule. At a meeting planned for mid-January, coordination results for a second group of breakdowns for six divisions will be presented by the S.A.I. This group includes Aerodynamics (2); Stress Analysis and Structures (7); Airplane Design and Description (10); Propellers (11); Fuels and Lubricants (12); Ordnance and Armament (22).

Because of the future importance of nuclear fission and its applications in the aviation field, it was unanimously agreed at the initial meeting of the S.A.I. Finalization Board to devote an entire division of the Index to this subject. The new division will be called Atomic Energy (48). This action demonstrates the extreme flexibility that is one of the highly desirable features of the S.A.I. The nature of the Index is such that divisions and sections, as well as subject headings, may be added or deleted without disturbing the structure of the Index, an important characteristic in a continually changing field.

The S.A.I. and its relationship to the high-speed, selective system of dissemination of technical intelligence evolved by the A.D.D. were explained by Lieutenant Colonel Arnhym at a

### (1) Guided Missiles

1. Guidance and Control
2. Launching
3. Propulsion
4. Aerodynamics and Ballistics
5. Warheads and Fuzes
6. Ground Handling Equipment
7. Auxiliary Equipment
8. Structures
9. Instrumentation
10. Production
11. Performance
12. Description
13. Operation
14. Testing

### (4) Power Plants, Rocket

1. Cooling
2. Control
3. Ignition
4. Exhaust Nozzles
5. Rocket Theory
6. Fuel System
7. Accessories
8. Combustion Chambers
9. Installation
10. Performance
11. Testing
12. Design and Description
13. Operation and Maintenance
14. Production

### (5) Power Plants, Jet and Turbine

1. Cooling
2. Induction System
3. Compressors
4. Combustion
5. Ignition
6. Exhaust System and Nozzles
7. Vibration
8. Fuel System
9. Lubrication
10. Accessories
11. Control
12. Combustion Chambers
13. Turbines
14. Components
15. Installation
16. Performance
17. Testing
18. Design and Description
19. Operation and Maintenance
20. Production

### (6) Power Plants, Reciprocating

1. Cooling
2. Induction and Supercharging
3. Combustion
4. Ignition
5. Exhaust System
6. Vibration
7. Fuel System
8. Lubrication
9. Accessories
10. Control
11. Components
12. Installation
13. Performance
14. Testing
15. Design and Description
16. Operation and Maintenance
17. Production

### (8) Materials

1. Ceramics
2. Plastics
3. Rubber, Natural and Synthetic
4. Wood
5. Leather and Textiles
6. Adhesives and Sealants
7. Dopes, Paints, and Finishes
8. Misc. Nonmetallic Materials
9. Iron and Alloys
10. Aluminum and Alloys
11. Magnesium and Alloys
12. Misc. Nonferrous Metals and Alloys
13. Powder Metallurgy
14. Sandwich Materials
15. General Data
16. Testing

### (9) Instruments

1. Engine Instruments
2. Flight Instruments
3. Navigation Instruments
4. Position Indicating Devices
5. Timing Devices
6. Flight Test Instruments
7. Accessory Instruments
8. Instrument Testing and Calibration
9. Automatic Flight Control
10. Installation

conference of librarians at Wright Field, December 8 and 9. Among those present were the representatives of the present A.D.D. Card Index Holders, which represents the substance of the captured documentation of the German Aeronautical technology. This project was completed in August, 1947, 15 months ahead of schedule.

## W. A. M. Burden Continues Library Gift

The generosity of W. A. M. Burden in depositing his aeronautical library with I.A.S. for the use of members and others is well known. His gift of sections of the library in 1945 and 1946 greatly increased the library resources owned by I.A.S., by adding more than 4,500 bound volumes of periodicals. Mr. Burden has continued this year with 2,147 of the books in his collection, 381 volumes of Government serial publications, and 156 volumes of American and foreign aeronautical house organs. Basic books and serials from the principal countries interested in aeronautical research and materials of great value for the study of aeronautical history are included in this important gift.

In acknowledging the gift, S. Paul Johnston, Director of I.A.S., said: "On behalf of the Officers and Council of the Institute, I want to express our great appreciation for your gift, not only for the books themselves, but for the evidence of your great interest in the Institute and in the things that we are trying to do. Lester Gardner built up a great tradition and a great asset in the aeronautical libraries concept which we are trying to maintain. Your knowledge of, and interest in, that work have been of great assistance to us, and I hope that we can continue to look to you for advice and counsel in that field."

## Driggs' Analytical System Saves Aircraft Research Time

Ivan H. Driggs, I.A.S. Fellow and Navy Bureau of Aeronautics' aerodynamacist, has developed an analytical system of applied aircraft design research which saves considerable time in the initial stages of research development programs, it was revealed by BuAer.

Consisting of a series of charts and tables illustrating the effect of variations in power-plant, electronic equipment, armament, and air-frame design on a given type of aircraft, the system permits large economies, BuAer stated.

▸ **System in Use**—Driggs' system, now in use, narrows the field of possible solutions of any problem to a relatively few specific design studies, allowing a proper choice following more detailed analysis.

Advantages of the analytical system are:

- It singles out the most promising aircraft type to develop at any one time and the compromises necessary to obtain a desired result, predicting the future effect to be expected from any course of action.
- Suggests the component development program required either to reach a solution to any task or to continue development.
- Indicates complete aircraft development possibilities, not only for the short term interim period but also for the long-range program as dependent on future development of the controlling factors, recommending types and sizes of various components that will be necessary for any plane either on an interim or long-range schedule.
- Provides officers charged with operational planning a means for determining future aircraft possibilities, thereby assisting in the specification of required types.

## Reprints of Anglo-American Conference Papers

All papers presented, together with discussions and proceedings, are being published by the Royal Aeronautical Society. The completed book, containing approximately 750 printed pages, will be available to I.A.S. members in March, 1948. Copies may be ordered in advance from the Institute at $10 for members and $12 for non-members.

## International Mechanics Congress to Meet in London in '48

Plans are under way for the 7th International Congress of Applied Mechanics, slated for London, U.K., September 5–11, 1948, at the Imperial College of Science and Technology, South Kensington, which American scientists and engineers of eight participating societies have been invited to attend.

Participating societies include the I.A.S., American Society of Civil Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers, American Institute of Chemical Engineers, the American Mathematical Society, Society of Automotive Engineers, and the American Society of Mechanical Engineers.

The A.S.M.E., as for the previous Congress held in Paris last September, is continuing the organization for participation in the next.

Technical sessions will include the following sections:

- Elasticity and plasticity.
- Aerodynamics, hydrodynamics, meteorology.
- Thermodynamics, heat transfer, etc.
- Vibrations, lubrication, and experimental methods.

In addition, at least ten general lectures or surveys are planned.

Registration fee of approximately $5.00 may be paid at time of registration or in advance to the organizing secretary at Imperial College.

## "Applied Mechanics Reviews" Off The Press

First issue of *Applied Mechanics Reviews*, new organ of the American Society of Mechanical Engineers, published with the cooperation of I.A.S. and other scientific societies, came off the presses this month.

An English abstracting and reviewing journal of world research literature in the field of applied mechanics, each issue is to contain approximately 200 reviews. Dr. Kenneth S. M. Davidson, I.A.S. Associate Fellow, is the Institute's representative on the publication's Policy Board, while Dr. S. Timoshenko, a Fellow and Professor Emeritus of Stanford University, acts as Consultant.

For detailed information about the *Applied Mechanics Reviews* contact The American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y.

## Gifts to the Institute Collections

Colonel E. E. Aldrin added 77 issues of aeronautical periodicals to his previous generous gifts. Four papers on stress analysis were received from Dr. Sandro dei Poli of Milan, Italy. The Aeronautical Digest Publishing Company, through the courtesy of Col. Nathaniel Silsbee, added 350 technical reports and periodicals to its previous gifts. The Texas Company, through the courtesy of M. P. Doss, presented a number of N.A.C.A. *Wartime Reports*. The Cornell Aeronautical Laboratory, through the courtesy of Miss Elma T. Evans, added three technical translations to the large number previously given.

W. A. M. Burden added 25 books and issues of 17 periodicals for 1947 to his large previous gifts. Dr. Otto Kallir gave a medal, "Award of the City of Philadelphia to Amelia Earhart, October 5th, 1932," which was

not previously in the collection, and otherwise increased his previous gifts. J. P. V. Heinmuller added an album of transoceanic air-mail covers and an album of Philippine air-mail covers to his previous generous gifts. Photographs of airplanes participating in the National Air Races of 1947 were given by Henry Clark of Saratoga Springs, N.Y. Mrs. Bella C. Landauer added a pamphlet on aviation ophthalmology to her previous generous gifts. The Air Materiel Command continued its previous gifts of reports, translations, index cards for captured German and Japanese documents, and microfilm copies of documents. Additional gifts were received from Arthur Halsted; National Research Council of Canada; and the U.S. Civil Aeronautics Administration, Civil Aeronautics Board, Navy Department, Office of Technical Services, and the War Department.

## I.A.S. Newslines

▶ Regular commercial travel on jet transports is 10 years away, **Wellwood E. Beall,** Boeing Aircraft Vice-President for Engineering & Sales and I.A.S. Fellow, declared, but, he added, U.S. will develop practical jet-propelled air liners "abreast of, or ahead of" any nation.

▶ **Dr. Karl T. Compton,** President of M.I.T. and a Fellow, recommends that the Air Force arbitrarily limit useful life of its planes and destroy them at its end. Only by that means, Compton said, could way be made for constant development and purchase of new craft. Also, he added, such action would avoid risk of counting totals of obsolete equipment and "lulling ourselves into believing we have an air force."

▶ Rock bottom minimum of $760,000,000 annually was estimated need of aviation industry by **Ralph S. Damon,** President of American Airlines and Fellow of the Institute. Damon divided total as follows: $300,000,000 for air frames; $300,000,000 for engines, propellers, and components; $120,000,000 to $150,000,000 for administration and research. At least two manufacturers, he said, should be working on each type of aircraft produced to maintain competitive factor.

▶ Streamlining N.A.C.A.... Following his extensive tour of N.A.C.A. facilities, **Dr. Hugh L. Dryden,** new Director of Research and I.A.S. Honorary Fellow, is quietly streamlining and strengthening technical committees, subcommittees, and their procedures. Top-notch research specialists from the labs have been placed in administrative posts in Washington, replacing predominantly clerical personnel.

▶ **Donnell W. Dutton,** Associate Fellow, is Professor, Daniel Guggenheim School of Aeronautics Georgia School of Technology.

▶ "Outstanding work in applied mechanics" won for **Dr. Jacob P. den Hartog** of the Dutch East Indies, a Fellow of the Institute, the American Society of Mechanical Engineers' Richards Award. Dr. den Hartog is Professor in Department of Mechanical Engineering, M.I.T.

▶ **Vice Admiral Emory S. Land** (ret.), President, Air Transport Association, received medal of French Legion of Honor for outstanding services performed in promoting cause of Franco-American relations. Admiral Land, a Fellow, was presented with the Order of Commander of the Legion from Henri Bonnet, French Ambassador to U.S. Citation was for the admiral's handling of French supply problem as Chairman of Maritime Commission.

▶ International Air Transport Association has named **John C. Leslie** to the I.A.T.A. Executive Committee. A Fellow, Leslie is Vice-President of Pan American Airways, Inc.

▶ Nation-wide poll by *Forbes* magazine adjudged **Glenn L. Martin,** Honorary Fellow and Past-President (1936), one of America's 50 foremost business leaders.

▶ Russia attempted to purchase B-29 parts—tires, wheels, and brake assemblies—**General Carl Spaatz,** Air Force Chief of Staff and I.A.S. Honorary Member, has revealed. U.S.S.R. offered an American rubber company a contract in 1946, he said, adding that it was turned down and reported to his office.

▶ New gas turbine laboratory, including supersonic wind tunnel capable of Mach Number 3, is under direction of **Prof. Edward S. Taylor,** M.I.T., a Fellow of I.A.S.

## Corporate Member News

• Withdrawal announced...**Aero Insurance Underwriters** has withdrawn from the aviation field, effective December 31. Company, which represented 30 fire insurance companies and six casualty firms in aviation field, will continue to service policies in force at year's end until they expire.

• Reorganization of its executive staff was announced by **Aeronca Aircraft Corporation.** Move resulted from resignation of John Friedlander as President. Elmer Sutherland, Acting General Manager, will be assisted by Sidney Brody, Vice-President-Secretary.

• A 100-year record of engineering and manufacturing was completed by **Allis-Chalmers Manufacturing Company** last year. Started in 1847, Allis-Chalmers represents an organization formed from 16 separate firms which today supplies more than 1,600 different products to industries throughout the world.

• Swords to dishwashers...Kitchen Kraft Corporation, Chicago, has given **Bell Aircraft Corporation** a contract for $10,000,000 worth of electric dishwashers. Bell is starting immediately with a pilot run of 25,000 units for which all materials are available; eventually will develop complete fabricating job, making all parts. Contract calls for 100,000 dishwashers inside of a year.

• C.A.A. has issued approved type certificate No. 793 on the Convair Liner, it was announced by **Consolidated Vultee Aircraft Corporation.** The certificate covers operation of the plane at 1,975 maximum engine horsepower, one of several versions of the Convair Liner with varying power plants, propellers, and configurations that Convair expects to certificate.

• Reversing the trend...All four props of a Douglas C-54 transport were reversed at an altitude of more than 10,000 ft. above Caldwell Airport, N.J., by **Curtiss-Wright Corporation's** chief pilot and director of flight operations. Result, it was reported, was that the pilot was able to make a far more rapid descent and a landing with a considerably shorter run than would have occurred under normal procedure. Plane was flying at a speed of 150 m.p.h. when props were reversed.

• **Ethyl Corporation's** research laboratories have been reorganized on a staff-and-line basis that groups personnel and equipment for maximum peacetime productive effort, company announced.

• NEPA Symposium...NEPA Division of **Fairchild Engine and Airplane Corporation** held a symposium on heat transfer at Oak Ridge, December 8–13. Meeting was in line with broad education program NEPA officials have set up to provide organized training in the many research subjects necessary for accomplishment of long-range mission of applying nuclear energy...Fairchild has concluded licensing agreement with National Bronze & Aluminum Co., Cleveland, for use of company's Al-Fin process.

• "Drying" holes in clouds...**General Electric Company** scientists, working on a joint research program with Army Signal Corps, Office of Naval Research, and U.S.A.F. at G-E's Schenectady Flight Test Center, reported a new method of combating icing conditions by "drying" holes in frigid clouds. "Seeding" supercooled clouds with dry-ice pellets the size of peas should clear holes within clouds large enough to permit safe landings and take-offs inside of 15 min., report said.

• **Walter Kidde & Company, Inc.**, has appointed Van's Air Service, St. Cloud, Minn., national distributor for the Kidde packaged carbon-dioxide system for light planes.

• "Oscar" for Annual Report... The Financial World has awarded **The Glenn L. Martin Company** the Oscar for the Aircraft Manufacturing Industry for excellence of its 1946 Annual Report to stockholders.

• **Menasco Manufacturing Company** elected a new President, Henry P. Nelson, to fill vacancy caused by resignation of John C. Lee last June. During late war, Nelson, who had been Executive Vice-President since August 15, was Director of the Aircraft Division, WPB.

• Christmas holiday of 11 days, with pay, was given all **Northrop Aircraft, Inc.**, employees. The year-end holiday, which is in addition to regular 2 weeks' vacation with pay provided all employees who have completed 1 year of service with Northrop, started at the close of the half-day shift on December 24, continued until regular starting times on January 5.

• An aeronautical radio station is being constructed at Haneda Airport near Tokyo by **Northwest Airlines, Inc.** Normal range of new station will be 3,500 miles—was scheduled for operation by first of year.

• Plans for Miami as the main engine overhaul center for its entire system have been advanced by **Pan American World Airways, Inc.** Proposed overhaul shops would be largest of their kind in the world. Proposal for new center was made at Dade County Port Authority meeting.

• Net profit of $395,147 for 6 months ended October 31, 1947, was reported by **Solar Aircraft Company.** Consolidated sales during that period were $7,177,052, compared with net sales of $4,685,682 during same period in 1946.

• Stinson Voyagers constituted 31 per cent of American planes exported to Brazil from July, 1946–September, 1947, it was reported by **Stinson Aircraft Division** of Convair, which said 138 Voyagers were delivered in that period to Brazil.

• New special fuels for jet, rocket, and ram-jet planes and guided missiles will be developed by **The Texas Company,** it was announced. A new laboratory, designed to conduct engineering research in the jet and rocket fields, is to begin operations this month at Beacon, N.Y. Lab will have a supersonic wind tunnel for testing all types of jet and rocket engines under simulated atmospheric conditions of up to 60,000 ft. at 2,400-m.p.h. speed.

• Purchase of twelve sleeper-type Constellations was authorized by board of directors of **Trans World Airline,** LaMotte T. Cohu, President, announced. The Connies, each of which will have sleeping accommodations for 40 passengers, will be put on the New York–Bombay, India, run. Present equipment will go into T.W.A.'s domestic service. Delivery is scheduled to begin in February.

• Air cargo operations by **United Air Lines** passed 2,000,000 ton-miles a month in October, 1947, representing a 43 per cent increase over the previous month. Included in the overall figure was a new high in air-freight operations for second month in a row, with an estimated 1,539,400 ton-miles in October against 1,074,375 ton-miles in September.

• **Weston Electrical Instrument Corporation** occupied its new engineering and administration building in Newark, N.J. With the new structure, Weston plant now consists of 380,000 sq.ft. of floor area in 19 buildings on 20 acres.

• Airports in Turkey... Equipment for ten civilian airports to be constructed in Turkey is now in production in six **Westinghouse Electric Corporation** plants. Initial shipment, scheduled for early last month, included high intensity runway lighting, instrument landing systems, radio navigational aids, and radio teletype point-to-point communications. In addition, terminal buildings, hangars, and airport auxiliaries will be furnished by Westinghouse.

# Sections and Branches

## Baltimore Section

David P. Samson, Jr., *Secretary*

Holding its first organizational meeting December 2, the new Baltimore Section of I.A.S. was formed with Joel M. Jacobson presiding as pro tempore Chairman.

Approximately 75 I.A.S. members, in addition to 36 nonmembers, attended the meeting.

▶ **Welcome New Section**—Introductory and explanatory comments were addressed to the group by S. Paul Johnston, Bennett H. Horchler, and Robert R. Dexter of the Institute, who took the opportunity to welcome the new Section into the I.A.S.

In the election of officers, the following were chosen: Joel Jacobson, Chairman; George N. Mangurian, Vice-Chairman; D. P. Samson, Jr.,

### *Calendar*

**I.A.S. Section Meeting**

**BUFFALO—FEB. 18**

Hotel Statler—Chinese Room

Speaker: Frank Andrix

"Servo Mechanisms—A New Engineering Tool"


*Silicone News*

DC SILICONES

## *Silastic* Seals Steam Iron*

In devices as varied as aircraft engines and steam irons, Silastic is proving its usefulness as a gasketing material. The reasons are obvious enough—if you know Silastic. These silicone rubbers are the only rubbery materials that stay elastic on continuous exposure to temperatures ranging from −70° to 400° F., and that have maximum weather resistance and minimum compression set at high temperatures.

A Silastic gasket seals the steam chamber of the "Monitor" steam iron, made by Parts Manufacturing Company, division of F. L. Jacobs Co. This iron reaches its operating temperature of 500° F. in three minutes.

In the case of the "Monitor" steam iron shown above, the design engineer listed the properties required to give him a satisfactory gasket to seal the sole plate to the sole plate cover. His list read as follows: Wanted, a material which is

insoluble in water
stable up to 500° F.
stainless and odorless
permanently pliable and elastic

He tested many materials trying to find that combination of properties. None of them would work. Several months later he got a sample of Silastic 125. It met his needs so exactly that it seemed made to order. The initial cost per iron was very low and life proved to be long. None of these gaskets have failed in two years.

In addition to gasketing applications, Silastic is being used more and more extensively as an electrical insulating material and as calking and potting compounds. The properties of the various Silastic stocks are described in pamphlet No. S 21-2.

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**DOW CORNING CORPORATION**
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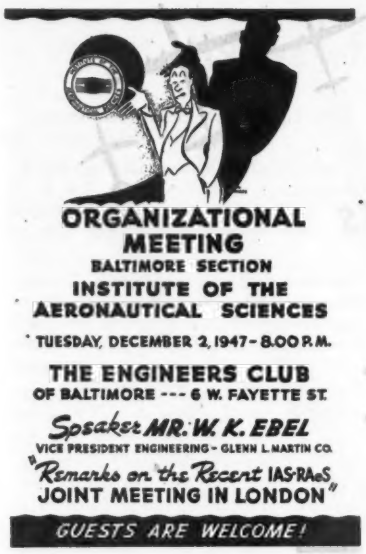
**ELECTROL** INCORPORATED

*FOR BETTER HYDRAULIC DEVICES*

*KINGSTON, NEW YORK*




**A colorful poster, printed at The Glenn L. Martin Company plant, successfully announced to the world at large the formation and organizational meeting of the new Baltimore Section of the I.A.S.**

Secretary; and Willis Benckert, Treasurer.

An Advisory Board of the following members also was elected: G. L. Bryan, Jr., D. R. Shoults, O. J. Schaefer, Dr. F. H. Clauser, Elgin Shaw, and Capt. C. H. Schildhauer.

At the conclusion of the election and installation of officers, the presiding Chairman, Joel Jacobson, introduced the principal speaker of the evening, K. W. Ebel, Vice-President of Engineering, The Glenn L. Martin Company.

▶ **London Meeting Discussed**—Mr. Ebel spoke of the joint meeting in London of the I.A.S. and Royal Aeronautical Society, discussing the highlights of various technical papers that were presented.

Mr. Ebel closed his talk with presentation of slides of British and American jet engines and airplanes. Performance comparisons were made of the various types and cutaway pictures of several engines were shown.

## Hagerstown Section

G. I. Hackenberger, Jr., *Secretary-Treasurer*

Following a report by the Nominating Committee read by Acting Chairman Roy Lessard, members of the Section heard Melvin N. Gough, Chief of Flight Research Division, Langley Memorial Laboratory, N.A.C.A.

Gough, an I.A.S. Fellow, opened his talk with a brief history of the problem of defining desirable flying characteristics of aircraft.

▶ **Terminology Not Scientific**—Before the era of technical flight testing as it is known today, Gough said, the pilot tried to convey to the engineer the behavior of the plane in qualitative terms.

Since even the terminology used to describe certain phenomena was not on a scientific or even universally accepted basis, little value was realized from flight testing. Progress in the flight-testing field was limited by the inadequacy of reliable instrumentation.

Not until it became possible to measure quantitatively and record certain parameters affecting stability and control, said Gough, was any definite advancement made in the prediction of handling characteristics of new designs while these were still on the drawing board.

▶ **Flight Instruments Shown**—Gough exhibited various types of flight instruments in present-day use and described others with the aid of slides, enumerating their functions.

The criteria for adequate stability were summarized, and the corrective action taken in specific designs to improve handling characteristics was discussed.

## New York Section

E. M. Lester, *Secretary-Treasurer*

First meeting of the 1947–1948 season, held November 21, 1947, featured Edward H. Heinemann, Chief Engineer of Douglas Aircraft, El Segundo Plant, who delivered a paper on the Douglas D-558 project.

Approximately 800 members and guests attended the meeting at the Engineering Societies Building in New York City. William R. Enyart, Chairman for the 1947–1948 season, was introduced by G. W. Brady, 1946–1947 Chairman. Mr. Enyart disclosed plans for the coming season, including the suggestion for several field trips.

▶ **D-558 Project**—In his paper, Heinemann described the purpose of the Navy-Douglas D-558 development to probe the sonic and high subsonic flight range by using rocket and turbojet propelled aircraft (AERONAUTICAL ENGINEERING REVIEW, December, 1947, page 14).

Mr. Heinemann also described the instrumentation of these airplanes for studies in flight of stresses and temperatures in the wings, fuselage, and empennage at flight Mach Numbers of 0.85 to 1.0.

▶ **Film of Record Flight**—Following the paper, a Douglas film of the record-breaking flights of the D-558 Skystreak was shown, in which the jet-powered plane was flown at a speed of 650.6 m.p.h.

A lively discussion of design and performance features of the D-558 followed the paper and movie.

## Philadelphia Section

John Rogers, *Secretary*

A joint meeting of the Section and the Franklin Institute, held November 5 under chairmanship of Capt. Ralph

(*Continued on page 67*)

**Officers and guests of the new Baltimore Section of the I.A.S.:** *Reading from left to right, front row, S. Paul Johnston, Director of the I.A.S.; W. K. Ebel, Vice-President of Engineering, The Glenn L. Martin Co.; Joel M. Jacobson, Chairman; George N. Mangurian, Vice-Chairman; D. P. Samson, Jr., Secretary; Willis Benckert, Treasurer. Back row: Robert R. Dexter and Bennett H. Horchler, Secretary and Executive Vice-President, respectively, of the I.A.S.*

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Type 756—24 volts d-c for engines up to 750 cu. in. displacement. Weight 19 lbs. Also available for same size engines is type 397 for 12 volt systems.

Type 1651—24 volt d-c for engines up to 3500 cu. in. displacement. Weight 27.00 lbs.

Type 1550—24 volt d-c for engines up to 4360 cu. in. displacement. Weight 26.95 lbs.

Type 1498—24 volt d-c for jet engines having moment of inertia of 187 lb-ft² and larger. Weight 27.75 lbs.

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# News of Members

**Charles Lee Baker, Jr.,** is Chief Engineer, Trans-Texas Airways.

**Nigel Bicknell,** former Wing Commander, R.A.F. Volunteer Reserve, has been appointed Department Head, Civil Air Attaché, British Embassy, Washington, D.C.

**John E. Burgeson** resigned as Assistant Design Engineer in McDonnell Aircraft Structures Department to become Design Engineer "A," The Ryan Aeronautical Company.

**Perry A. Clark,** former Power Plant Engineer, T.W.A., now is Industrial Salesman, The Texas Company.

**George A. Christiansen** is Test Engineer with McDonnell Aircraft Corporation. He resigned a like post with Fairchild Engine & Airplane Corporation's Personal Planes Division.

**William C. Coulbourn** is now Executive Engineer with Specialties, Inc.

**Harry P. Dobrow,** Associate Fellow, who had been with Willys-Overland Motors as Head of Analytical Engineering Department, was named Assistant to Chief Chassis Engineer, Hudson Motor Car Company.

**Carl F. Eck,** former pilot with T.W.A., is now Engineering & Air Safety Representative, Air Line Pilots Association.

**Carmelo A. Frontario** is Inspector-Quality Control, Republic Aviation Corporation. He had been Chief Procurement Inspector, Air Materiel Command.

**Frank D. Graham,** former Research Assistant, Aeronautical Engineering Department, Princeton University, is with Boeing Aircraft Company as Aerodynamicist.

**Captain Harold E. Gray,** one of Pan American Airways best known master pilots, was named Division Manager of the Pacific-Alaska Division. In his new post, Gray will be right-hand man to Thomas Wolfe, Vice-President in Charge of Engineering in an international operation extending from Alaska to Australia, and from California to Calcutta.

**Alan H. Green** is Aerodynamicist, Douglas Aircraft Company, Inc.

**Frank C. Hannam** is at Sacramento Municipal Airport as Aircraftsman.

**Albert T. Hapke, Jr.,** formerly with the Petroleum Institute, is now with Robinson, Hapke Company.

**Henry G. Hotchkiss** is a partner with Spence, Hotchkiss, Parker & Duryee.

**Basil Jackson** is Technical Author in charge of the Technical Publications Department, Messrs. John Curran Limited. He formerly was Technical Author at Airspeed Ltd., England.

**Morton Kantor** is with Chance Vought Aircraft Division, United Aircraft Corporation, as Aerodynamicist.

**Eugene K. Liberatore,** a former Engineer at the Naval Aircraft Factory, Philadelphia, now holds the same post with Wing Engineering Corporation.

Harold E. Gray.

Roscoe I. Markey.

Captain Albert B. Scoles, U.S.N. (ret.).

**John L. Longden,** Flying Officer, R.A.F.V.R., is Consulting Engineer, Associated Industrial Consultants Ltd., England.

**Horace C. Luttman,** Associate Fellow, is with A. V. Roe Canada Ltd. He was Director, Aeronautical Inspection, Ministry of Aircraft Production, England.

**Roscoe I. Markey,** Associate Fellow, joined Fairchild Aircraft Division of Fairchild Engine and Airplane Corporation to assume charge of a technical division of the Engineering Department.

**Joseph J. Mascuch** is President, Victory Engineering Corporation.

**Zygmunt John Norton-Nowakowski,** Associate Fellow, is Director, General Manager, Mondex Engineering & Sales Ltd. (Canada).

**H. H. Ogren,** former Engineer with Boeing, is Engineer, Northern Ordnance Company.

**Willard W. Parker** resigned his post at Green Lake Airports to become Flight Test Engineer, Grumman Aircraft & Engineering Corporation.

**Paul E. Richter,** Associate Fellow, is President and Chairman of the Board, TACA Airways, S.A.

**Frank Roberts, Jr.,** is Teaching Fellow in Aeronautical Engineering, University of Notre Dame.

**W. C. Rockefeller,** General Manager of Alvin P. Adams & Associates, Los Angeles, aviation consultants, has been elected to the Board of Directors of Consolidated Vultee Aircraft Corporation.

**Boniface E. Rossi** is Principal Engineer, B. E. Rossi Engineering Associates.

**Robert Sanders** is President and General Manager, Sanders Aviation, Inc.

**Gustav H. Schirrmeister,** formerly with American Airlines, is with New York Port Authority as Airport Designer.

**Captain Albert B. Scoles,** U.S.N. (ret.), has been appointed Director of Technical Liaison, Pilotless Plane Division, Fairchild Engine and Airplane Corporation. Captain Scoles left the post of Technical Director of the Naval Air Missile Center at Point Mugu, Calif., where he was instrumental in the development and testing of guided missiles. A graduate of Annapolis in 1927, he later obtained his aeronautical engineering degree at Cal Tech.

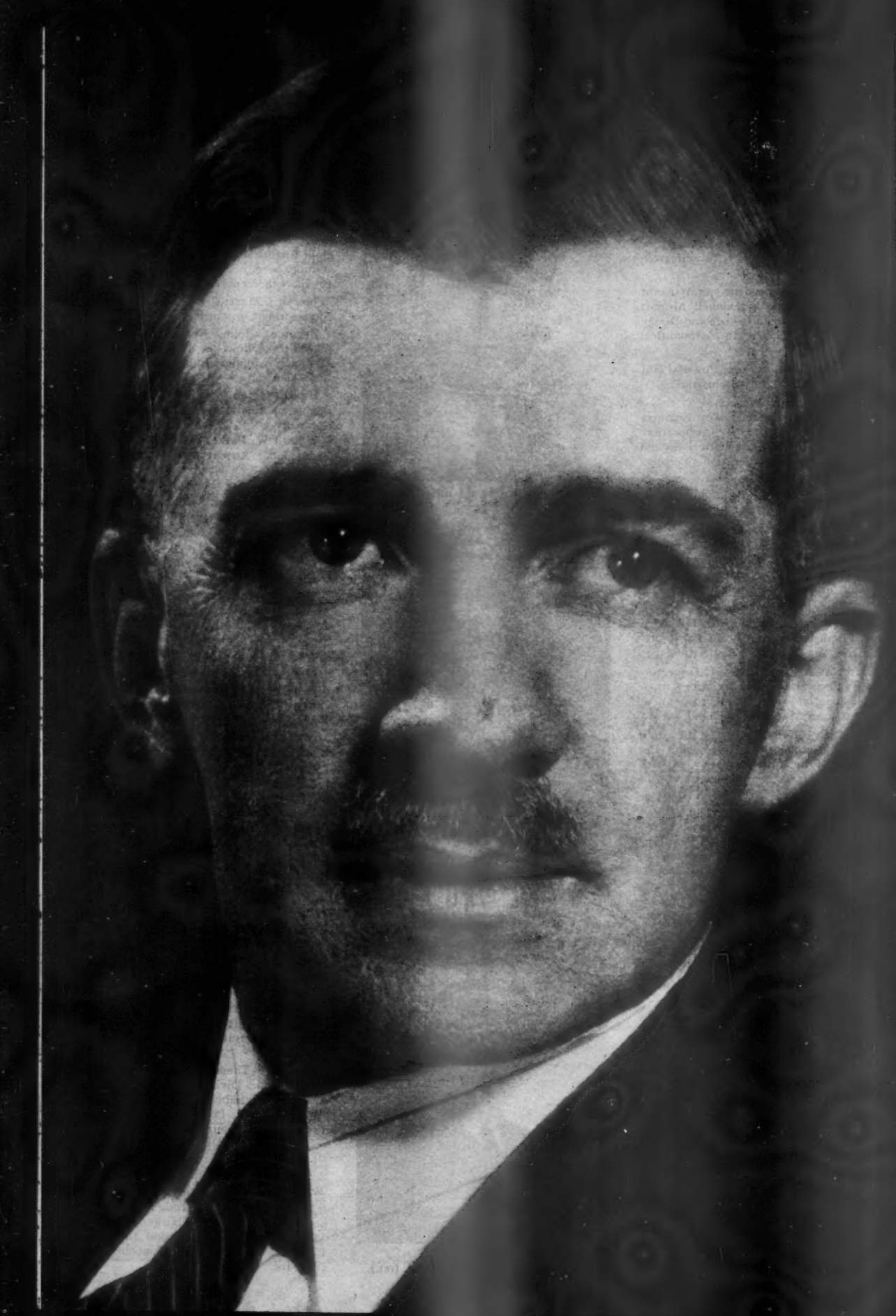
**Leo S. W. Smyth,** Flight Lieutenant, R.A.A.F., now is R.A.A.F. Resident Technical Officer, de Havilland Aircraft Ltd. (Australia).

**George Tharratt,** Associate Fellow, left Douglas Aircraft as Preliminary Designer to become Consulting Engineer in his own business.

**Theodore Theodorsen,** Fellow, former Chief, Physics Division, Langley Memorial Aeronautical Laboratory, N.A.C.A., was appointed Vice-President, Institute of Technical Aeronautics and Dean of the School of Aeronautical Engineering, Brazil.

**Peter Torraco** is Chief Design Engineer, Aircraft Service Corporation.

**Kenneth B. Turner** resigned as Engineer, Bristol Aircraft Division, Universal Molded Products Corporation, to become Engineer, Plastics Division, Lincoln Industries, Inc.



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# Editorial

## Change in Command

One of the most satisfactory arrangements that have been handed down by the Council of the Institute is in the special position accorded to Past-Presidents in the year immediately following their retirement from office. Although they are relieved from active responsibility for the direction of the Institute, as ex-officio members of the Council the experience they have gained may be ploughed back and not lost. We can continue to look to them for advice and counsel.

The arrangement is a particularly happy one when a man of the caliber of our retiring President, Preston Bassett, lays aside the gavel. During what might have been a difficult year, he has proved himself a great friend and a tower of strength to this organization. Extremely busy with his own affairs, he has never hesitated in giving whatever time and energy was needed, when it was needed most. His persuasive personality, his simple and direct manner have smoothed over situations that might have been more than rough. He has made many friends for the Institute on both sides of the Atlantic. We are very glad that the pleasant associations of the past year need not be broken off completely as he steps down from office.

Traditionally, the Presidency of the Institute shifts in alternate years from West to East. This also has proved a wise decision from the past. But its importance is not in emphasizing the distance from Coast to Coast, but in *minimizing* it. The Laws of Aerodynamics and the Law of Gravity operate in the same manner in New England as in Southern California. What is discovered in one section is immediately useful in every other. The mission of the Institute is to spread the word as rapidly and as completely as possible to all corners of the country. The aeronautical sciences know no boundaries. They harbor no local interests.

By the time this issue of the REVIEW is in circulation, our new skipper will have reported aboard. Elsewhere (page 5) we have announced the facts of his election. It is unnecessary to introduce Jack Northrop to an I.A.S. audience. We all welcome him, and, members and staff, pledge him our utmost cooperation in the year ahead.

And the year 1948 will be a critical one for aviation in America. Aeronautical engineers have designed and developed for our air forces air weapons that are unmatched elsewhere in the world. They have done their part and have done it well. It is now up to the people of the United States to decide what they want to do about it. They can have security if they want it, provided they realize that adequate air power is the only guarantee of "Survival in the Air Age."

S. P. J.

**Preston R. Bassett, retiring President of the Institute. His successor is John K. Northrop, who will be inducted into office at the Honors Night Dinner, January 26.**

# The Place of the Aviation Physiologist in the Aeronautical Sciences*

M. C. SHELESNYAK†
*Office of Naval Research*

M. C. Shelesnyak

THE ADVENT OF AVIATION has taken man well beyond the limits of the natural environment of the Earth's surface, an environment to which he has been adapted by years of evolutionary development. In order to permit man the fullest exploitation of the engineering achievements in aviation, it has become increasingly necessary to exercise cooperative endeavor between the student of man and the student of the machine. Actually, a new discipline in the biology of man—*aviation physiology*—has been established.

This field of science deals with the responses of man's functional processes to the environmental conditions encountered in aircraft. Man as a vital organism is "an exquisitely integrated mechanism, the behavior of which is essentially the summation of actions and interactions of a mass of living cells, of groups of specialized cells called tissues, of combinations of tissues to make body organs; of body organs systems, of the organism as a whole, and of the interrelations of organisms (men). These reactions and interactions are continually influenced by physical, chemical, and emotional factors of the environment—internal and external."[1]

The environmental factors of primary concern to the aviation physiologist are those encountered in flight in aircraft. Outstanding and most common factors are those associated with altitude as reflected in anoxia (oxygen want); aero-embolism (aviators' bends); low temperature; changes in altitude as reflected in ear and sinus ventilation; high speed as reflected in the development of forces of acceleration with gray-out and black-out; and motion sickness, vibration, noise, crash injury, and escape.

The experience of the recent war has clearly shown that the greatest economy of effort can be achieved only when the human factors are considered in the earliest stages of the engineering design. It was necessary to effect a close working partnership of the aircraft designer, the aviation physiologist, and the pilot. To this end both services, the War Department and Navy Department, utilized many young men who had experience and training in physiology.[2] A group of several hundred physiologists devoted their time to teaching pilots about matters dealing with the physiological aspects of flight, to experimenting in the laboratory and aircraft, and to establishing physiological criteria for equipment, such as oxygen regulators, anti-*g* suits, goggles, and the like.

After demobilization most of these scientists and technicians returned to academic posts where their aviation training has been shelved and their contact with aviation development minimized. This group, however, forms an important corps essential to the fullest development of aviation and vital for national security, and it should be encouraged to maintain a continuing interest with the aviation industry and its newer developments.

It is the aim of this paper to present some methods for the re-vitalization of the group of aviation physiologists. The writer is aware that the optimal means for nurturing this group of scientists and technicians is by active employment within the field of aviation physiology—in engineering schools, industry, Government, and university research laboratories. However, the formulation of a body of specialists, an expression of the services that such a group offers, and an examination of professional opportunities by the industry are necessary prerequisites to a program for gainful employment.

The author of this paper has raised some provocative and interesting questions. Readers are invited to send in their comments, which will be forwarded to the author.

**Editor**

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* The opinions expressed in this paper are the author's and do not constitute official Navy Department opinion.

† Head, Human Ecology Branch, ONR, Navy Department.

It is suggested that a continuing interest be effected in the following manner:

(1) *Men who have served during the war as aviation physiologists should be invited by the leadership of the Institute of the Aeronautical Sciences to form a professional group either independent of, or as an auxiliary group under, the Institute of the Aeronautical Sciences or the Aero-Medical Association.* It may be commented that association with the Institute of the Aeronautical Sciences appears preferable. This is based on the concentration of all aeronautical problems under the scope of the interests of the Institute of the Aeronautical Sciences and upon the probability of a closer association with the engineering, design, and training (technical) aspects of aviation. The group should be composed entirely of men who are concerned with the physiological and psychophysiological aspects of aviation as distinct from problems in selection and training and medical flight examining. This restriction is suggested as a means to strengthen the technical group that was primarily interested in the functional aspects of the aircraft as related to man. The other groups serve important, but otherwise oriented, problems and are, incidentally, more cohesive.

(2) *The aircraft industry should be encouraged to examine the personnel roster of the aviation physiologists and invite qualified men to participate in their research organizations either as members of the staff or as consultants.* It is true that some members of the aircraft industry have consultants for the physiological aspects of their problems, but it is not widespread, nor does it reach enough of the war-trained aviation physiologists to maintain their active interest.

It should also be added that since the end of the war the association of the engineer and the physiologist has been much diluted, and it is precisely now that the engineer-physiologist team should be reinforced. In an article on "Pilot-Aircraft Integration," the writer stated: "The recent history of the relationship between medical science and aeronautics shows a continuing effort to fit the human element into the engineered structure. As a result man has been given more and more items of protective equipment and physiological props to permit him to operate the aircraft. At the same time, these protective measures for man often involve performance penalties and structural modifications of the airplane.

"It now appears that a state has been reached where further trussing of the man and patching of the airplane becomes prohibitive in cost of human efficiency and aircraft performance. Therefore, the aeronautical engineer and medical scientist, or flight physiologist, must work together from the drawing board stage of aircraft design unto final production of the plane." Although the paper was pointed toward combat-type aircraft, the essential validity for combined effort of the designer, engineer, and flight physiologist obtains for all aircraft.[3]

(3) *A course or courses dealing with the functional man, especially physiology of flight, should be incorporated in the training of aeronautical engineers.* The inclusion of such material in the curriculum would afford the opportunity of inculcating information regarding human factors in the engineering training of future engineers and designers and permit aviation physiologists a more active participation in aeronautical groups.

The need for greater concern about the physiological capabilities and limitations of man becomes increasingly essential for all engineers, for in the final analysis the services of the engineer are services to aid man in the performance of tasks and to offer man environments optimal to his functional parameters. To the aeronautical engineer this has become far clearer than to other engineers, since the aeronautical scientist has literally projected man far beyond his natural environment, and, in order to permit man to stay with the machine, the limits and tolerances of the human being must be considered.

Such training in human biology as is contemplated would be given not to attempt the development of physiologists out of engineering students but rather to offer enough basic theory of the function of man so that the engineer will be continually aware of man's structural and operating limits and know where to invite participation of the specialist—the aviation physiologist.

### References


[1] Shelesnyak, M. C., *Some Problems of Human Ecology in Polar Regions*, Science, Vol. 106, No. 2757, pp. 405–409, October, 1947.

[2] Bronk, Detlev W., *Human Problems in Military Aviation*, Proc. of the Amer Phil. Soc., Vol. 88, No. 3, pp. 189–195, September, 1944.

[3] Shelesnyak, M. C., *Pilot-Aircraft Integration*, Aero Digest, Vol. 53, No. 6, pp. 44–45, 122, 125, 126, December, 1946.



## *Coming in the February Review*

**"Engineering for Safety" by William I. Stieglitz, Republic Aviation Corporation**

*and*

**"The Design Engineer's Role in Airplane Cost Reduction" by H. G. Erickson, Luscombe Airplane Corporation**

# General Results of N.A.C.A. Flight Research in Natural Icing Conditions During the Winters of 1945 and 1946

NORMAN R. BERGRUN*

*National Advisory Committee for Aeronautics*

SUMMARY

Further flight tests in natural icing conditions have been conducted with a Curtiss Wright C-46 airplane equipped with a thermal ice-prevention system. Special meteorological instruments and heated test sections, not available during previous tests, were employed to measure the meteorological factors conducive to aircraft icing and the amount of heat required for ice protection on various components of the airplane. In addition, general observations were noted on the performance of the airplane thermal ice-prevention system.

The test program extended from January, 1946, to May, 1947, and icing was encountered 75 times during flights throughout the United States. Meteorological measurements of altitude, free-air temperature, liquid-water content, and drop size were obtained for both layer- and cumulus-type clouds. In some instances, corresponding heat-transfer data were obtained for the heated test equipment.

The test results indicate that (1) meteorological predictions of large liquid-water contents in the tops of clouds characterized by strong vertical currents (cumulus) are sound; (2) liquid-water concentrations in cumulus clouds can readily achieve twice the value associated with layer-type clouds; (3) the size of cloud droplets has an important bearing on the amount of heat required for protection of a given airplane component; and (4) a thermal ice-prevention system having dry-air performance equivalent to the C-46 installation will provide satisfactory protection for virtually unlimited flight in icing conditions.

## INTRODUCTION

THE HAZARD associated with encountering icing clouds during flight has long been recognized as one of the foremost problems confronting pilots. In an effort to alleviate this problem, the National Advisory Committee for Aeronautics has, for a number of years, conducted research on the prevention of ice formation on aircraft through the use of heat. During the war years, satisfactory wing, empennage, and windshield thermal ice-prevention systems, utilizing heat from exhaust gas, were designed, fabricated, and tested in natural icing conditions for the Lockheed 12-A, Consolidated B-24, Boeing B-17, and Curtiss-Wright C-46 airplanes (references 1, 2, 3, and 4, respectively). Each of these designs was based on establishing, for clear air conditions, a surface temperature rise that experience had shown to be adequate for ice prevention in simulated and natural icing conditions. This dry-air design criterion, because of its empirical nature, was obviously limited in its application, and, with the advent of aircraft with appreciably higher cruising speeds than were available with the airplanes tested, the need for a fundamental design procedure became apparent. Until recent flight tests, the design of thermal ice-prevention equipment was retarded greatly by a lack of knowledge of the physical characteristics of icing conditions, as well as by a lack of data in regard to the exact processes by which water intercepted by a heated body is dispersed.

To obtain fundamental data on both meteorological factors conducive to icing and heat-transfer processes governing the operation of thermal ice-prevention equipment, a Curtiss-Wright C-46 airplane that had been provided with a thermal ice-prevention system[4] was equipped with special meteorological and electrically heated test apparatus and was flown in natural icing conditions during the winters of 1945 and 1946.

The flight tests were conducted along air-line routes over most of the United States, and, during the conduct of the tests, valuable assistance to the research program was given by United Airlines, Inc., who provided communication, maintenance, and weather-forecast facilities under a contract with the N.A.C.A. Other valuable contributions were made by the Air Materiel Command, Army Air Forces, and the U.S. Weather Bureau, who actively cooperated in the research.

## DESCRIPTION OF EQUIPMENT

### *The Airplane*

The C-46 airplane, shown in Fig. 1, is a twin-engined, low-wing, transport airplane powered by two model R-2800-51 engines having a sea-level rating of 2,000 hp. each. The airplane had been modified to provide a thermal ice-prevention system by which heated ram air was distributed to the leading edges of the wings and tail surfaces. Additional ice protection was afforded by the installation of electrically heated shoes on the propeller blades.

### *Research Equipment*

Research equipment used during the flight tests consisted of apparatus to measure the meteorological factors conducive to icing and the heat-transfer processes that occur over aerodynamic bodies.

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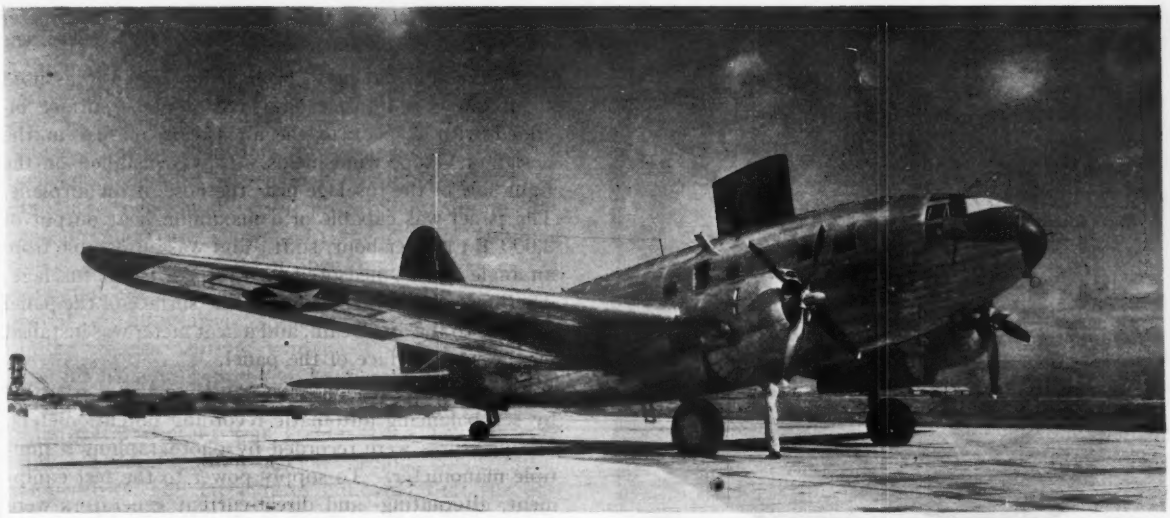


FIG. 1. The C-46 airplane equipped for research flights in natural icing conditions for the winter 1945–1946.

Design of thermal ice-prevention equipment on a fundamental or so-called "wet-air" basis requires a knowledge of certain meteorological quantities with respect to icing clouds. These quantities are: (1) drop size; (2) drop-size distribution; (3) liquid-water content; and (4) free-air temperature.

During the 1944–1945 season, a method utilizing knowledge of the dew point of the air was used to obtain data on liquid water content, but, because of various difficulties associated with its use, the dew-point method was replaced by a method based upon knowledge of water-drop impingement on cylinders.[5] This latter method, in addition to providing data on liquid-water content, was used to determine drop diameter and drop-size distribution.

To study heat-transfer processes over heated wings in icing conditions, two electrically heated airfoils, each with an 8-ft. chord and 5-ft. span, were constructed for obtaining test data. Each airfoil was mounted vertically on top of the fuselage of the C-46 airplane. The airfoil tested during the winter of 1945–1946 had an NACA 0012 section; the one tested during the winter of 1946–1947 had an NACA 65,2-016 section (Fig. 2) in order to provide data for low-drag sections. Each airfoil had a heated test section of 1-ft. span located 2 ft. above the top of the fuselage. The airfoils contained electrical heating elements that allowed a variety of chordwise heat distributions. In addition, thermocouples and pressure orifices were installed on the test-section surfaces.

To study the heat-transfer processes over windshields, three different designs were employed during the 1946 flights.

For obtaining heat-transfer data for a faired-in windshield (i.e., a windshield conforming to fuselage contours). an electrically heated transparent panel (Fig. 3) was installed in the conventional C-46 windshield on the right side of the airplane. Surface heating was supplied by fine resistance wires imbedded in a plastic layer under the outer layer of glass. The

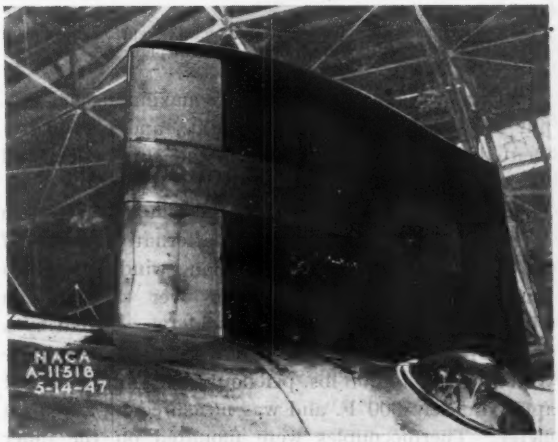



FIG. 2. Electrically heated NACA 65,2-016 airfoil mode mounted on top of the C-46 fuselage.

FIG. 3. Electrically heated faired-in windshield panel, viewed from exterior of the airplane.

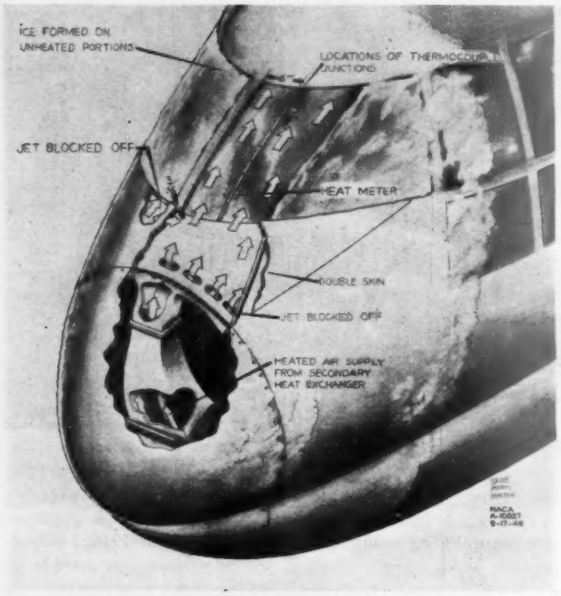



FIG. 4. External discharge heated-air ice-prevention system for faired-in windshield of C-46 airplane.

panel was capable of delivering a maximum heat output of 1,000 B.t.u. per hour, sq.ft., and was instrumented with thermocouples on the surface exposed to the air stream.

An external heated-air discharge windshield system (Fig. 4) was investigated as an alternative means of providing ice protection for airplane windshields. In this system, an external region over the faired-in windshield surface on the pilot's side was heated by a hot-air jet. The discharge rate from the jet could be varied from 0 to 500 lbs. per hour at a temperature of approximately 300°F. and was measured by a venturi meter. Thermocouples were mounted on the inner and outer surfaces of the windshield, and a heat meter was located on the inner surface.

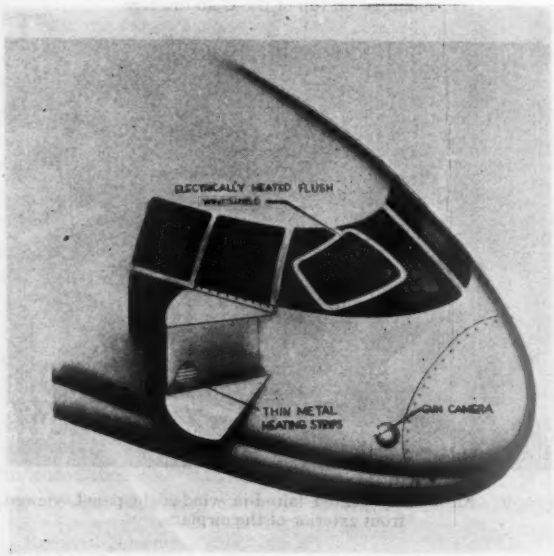



FIG. 5. Adjustable flat-plate windshield and flush windshield panel.

A simulated flat-plate windshield (Fig. 5) was used to obtain heat-transfer data over a plane surface inclined with respect to the air stream for use in the design of V-type windshields. It was installed on the right side of the fuselage near the nose of the airplane. The panel was capable of a maximum heat output of 3,000 B.t.u., per hour, sq.ft., and was adjustable from an angle of 75°, measured with respect to the fuselage. Thermocouples were located on the surface of the panel exposed to the air stream, and a heat meter was installed on the back surface of the panel.

Temperatures from all test equipment were recorded by self-balancing automatic recording potentiometers, and pressures were recorded by photographing a multiple manometer. To supply power to the test equipment, alternating- and direct-current generators were used. All navigation instruments were conventional types.

## TEST PROCEDURE

The flight-test program began late in January, 1946, and was continued through the following winter until May, 1947. During this time 75 flights were made in icing conditions.

Current meteorological reports relating to the prevailing lapse rate, freezing level, cloud-type frontal position, and frontal movement were found to be helpful in planning the flights. Since experience gained in conducting the research flights showed that the most severe icing conditions were to be found in cumulus clouds having no precipitation and that these clouds usually prevailed after the passage of a cold front, an attempt was made to operate frequently in postfrontal activities.

During the conduct of the flight tests in icing regions, the usual procedure was to fly the airplane straight through ice-cloud formations, according to the flight plan, recording data continuously with all equipment.

Some ice-cloud structures were found to be of such interest that it was desirable to traverse these clouds thoroughly. However, this generally could not be done, because heavy air traffic and poor communication equipment performance due to icing conditions almost always precluded any change in flight plan aloft.

## RESULTS AND DISCUSSION

A great deal of meteorological and heat-transfer data were obtained in natural icing conditions with the test apparatus installed on the airplane, but, because of the many ramifications that studies of these data yield, only a résumé of results is presented here.

### *Meteorological Research*

In the design of thermal ice-prevention systems on a fundamental basis, data concerning the values of drop-diameter, liquid-water content, and free-air tem-

perature to be expected in icing conditions are required. A summary of icing conditions experienced during the many flights with the C-46 airplane is presented in Fig. 6. These data, taken from references 6 and 7, reduce all icing conditions to being characteristic of two general cloud types—namely, cumulus and stratus. For these two cloud types, probable maximum and typical values are shown. In the case of cumulus clouds, the value of 2.0 Gm. per cu.m. is given as the estimated maximum liquid-water content* to be expected in all-weather transport operations in the United States during winter. The corresponding drop diameter was chosen as 20 microns,† which represents the average of seven observations in which the liquid-water content was greater than 1.2 Gm. per cu.m. A consideration of cloud height, condensation temperature, and lapse rates indicated that the corresponding temperature is likely to be as low as 0°F. However, because of the inherently discontinuous nature of cumulus clouds, duration of flight in them is seldom longer than 1 min. at a flight speed of 160 m.p.h.

In contrast to cumulus clouds, which are formed by the rapid rising of individual masses of air potentially warmer than the air mass as a whole, stratus clouds generally extend over large areas as a result of turbulent mixing of entire layers of air. Thus, by the nature of formation of stratus clouds, continuous icing in them can be expected, but, because of their limited vertical extent, the amount of liquid water in them never reaches as high values as in cumulus clouds. With decreasing temperatures, the amount of liquid water existing is, in general, reduced, although the drop diameters are about the same. For relatively warm temperatures (20°F.), drops as large as 25 microns might be expected.

The estimated maximum conditions are encountered infrequently, and, therefore, interest also centers upon those icing conditions that are in the majority.

In these instances, for cumulus clouds, a typical value for liquid-water content is about 0.8 Gm. per cu.m. with drop diameters ranging from 10 to 17 microns at temperatures from 0 to 20°F.; for stratus clouds, a typical value is only 0.3 Gm. per cu.m. with drop diameters in the same range as for cumulus clouds but at higher temperatures (10° to 25°F.). In addition to the conditions presented, sometimes extremely large drop sizes (40 to 50 microns diameter) are encountered with low liquid-water contents (0.1 to 0.2 Gm. per cu.m.).

As a result of this research, it is believed that the meteorological conditions conducive to icing are sufficiently defined for the design of thermal ice-prevention equipment.

| MOST PROBABLE MAXIMUM | | | | |
|---|---|---|---|---|
| C U | 1 MIN. | 2.0 Gm/m$^3$ | 20 | 0°F |
| ST OR SC | CONT. | 0.8 Gm/m$^3$ | 15 | 20°F |
| | | 0.5 Gm/m$^3$ | 25 | |
| | | 0.5 Gm/m$^3$ | 15 | 0°F |
| | | 0.25 Gm/m$^3$ | 15 | -20°F |
| TYPICAL OR NORMAL | | | | |
| C U | 1 MIN. | 0.8 Gm/m$^3$ | 10 to | 0° to 20°F |
| S C | CONT. | 0.3 Gm/m$^3$ | 17 | 10° to 25°F |

FIG. 6. Icing conditions to be anticipated in all-weather operations.

### *Heat-Transfer Research*

*Wings.*—The ultimate in performance of a wing thermal ice-prevention system is one that will prevent the accretion of ice on any portion of the wing. This ideal operation requires that any water on the wing must be maintained in the liquid state until it evaporates or flows off the wing at the trailing edge. In many wing designs, heating of the entire surface is not practicable because of such features as integral fuel tanks; in these instances, any water flowing aft of the heated region is likely to freeze and form the type of accretion called "runback."

Equations that express the amount of heat required to fully evaporate water from a wetted wing surface were developed by John K. Hardy, of the Royal Aircraft Establishment, Farnborough, England.[8,9] A graphical representation of the operation of a heated wing based upon Hardy's equations is shown for the NACA 0012 heated airfoil in Fig. 7. Reference 10 points out that the rate of evaporation of water, which is the determining factor in the requirements of total heat flow and extent of heated area, is denoted by the area between the curves for total heat flow and convective heat loss, except in the region of water impingement. In the region of impingement, the rate of evaporation is given by the area between the curve showing the heat loss due to warming the intercepted water and the curve for the heat loss due to convection. Thus, for a given wing section of a thermal system, it can be determined whether all the water impinging

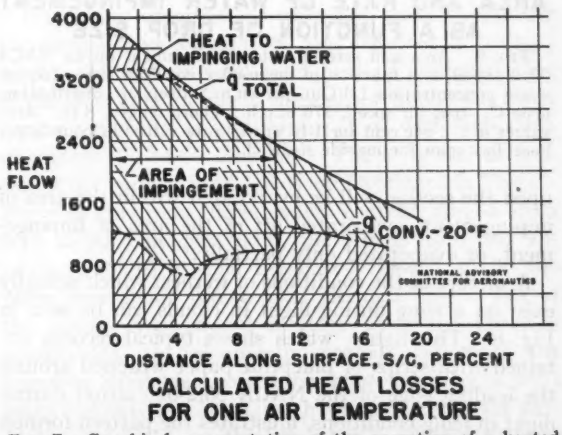



FIG. 7. Graphical representation of the operation of a heated wing.

* The term "liquid-water content," which describes the amount of water in a cloud, is usually expressed in grams of water per cubic meter of air, or simply grams per cubic meter. A gram per cubic meter is the same as one cubic foot of water per million cubic feet of air.

† One micron equals $^1/_{1,000}$ millimeter.

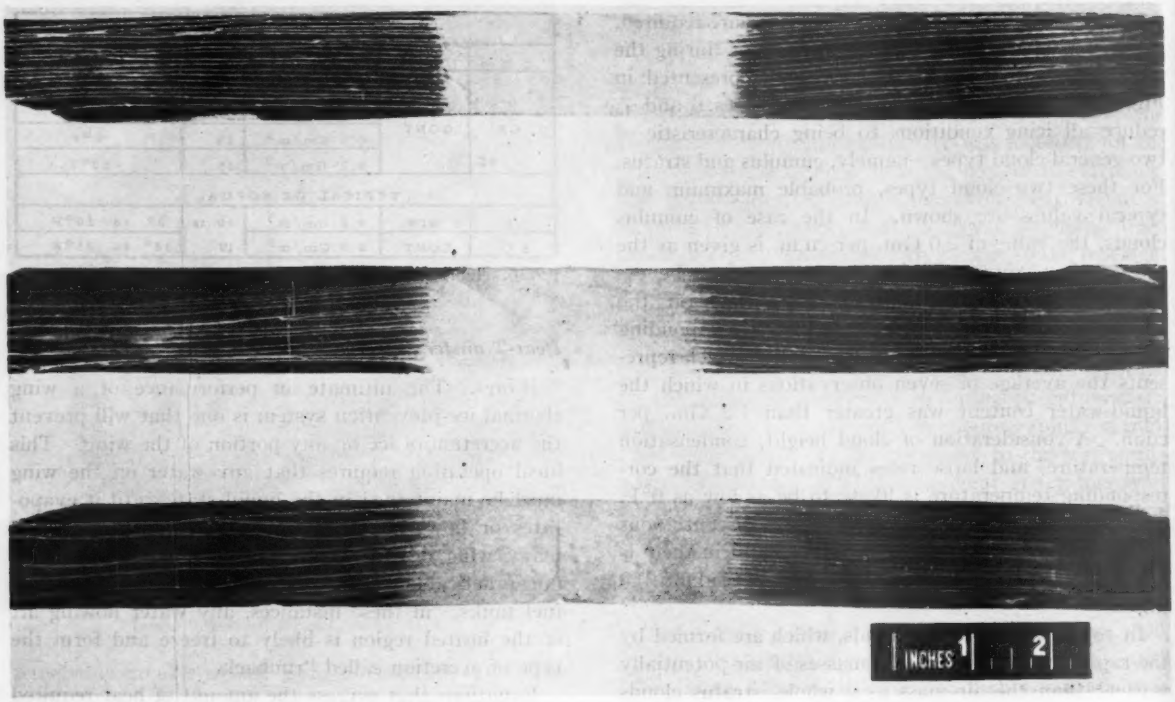
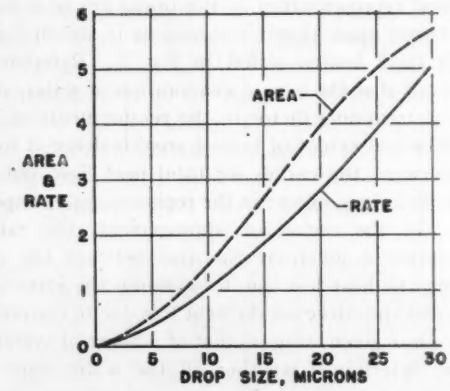



FIG. 8. Typical records obtained with blueprint paper strips on the NACA 65,2-016 airfoil model, showing pattern formed by water in striking the leading edge and flowing aft.




**AREA AND RATE OF WATER IMPINGEMENT AS A FUNCTION OF DROP SIZE**

FIG. 9. Area and rate of water impingement on an NACA 0012 airfoil as a function of mean-effective drop size. Liquid-water concentration 1.0 Gm. per cu.m.; drop-size distribution, type C; true air speed, 170 m.p.h.; chord length, 8 ft. Area values in *s/c* per cent for 1-ft. span; rate values in pounds per hour, foot span, for one side of airfoil.

upon the section will be evaporated within the area of impingement, evaporated aft of the area of impingement, or evaporated only partially.

A picture of the conditions of wetness which actually exist on a wing during flight in clouds can be seen in Fig. 8. This figure, which shows typical records obtained with strips of blueprint paper wrapped around the leading edge of the NACA 65,2-016 airfoil during flight in icing conditions, illustrates the pattern formed by the water in striking the airfoil leading edge and flowing aft. It appears from the patterns that the area of impingement, which is clearly defined, is completely wetted, while back of this area the water collects and forms rivulets, creating a partially wetted surface. Thus, it is apparent that, aft of the area of droplet interception, efficiency of removal of water by evaporation is decreased markedly because the surface is only partially wet. This indicates that the more of the total water intercepted and evaporated in the area of impingement, the greater the efficiency of the thermal system becomes.

To ascertain the minimum heat flow and smallest heated area needed for complete ice prevention, it is apparent that the area, rate, and, to a lesser extent, distribution of water drop impingement are important factors in establishing the optimum heat flow for a wing thermal system. Previous efforts to predict area and rate of impingement on airfoils utilized theoretical calculations for cylinders.[5] Use of these data assumed that the leading-edge region of the airfoil could be replaced by a cylinder, the radius of which is equal to the leading-edge radius of the airfoil. Preliminary calculations indicated that considerable error might result by making this substitution. Therefore, extensive water-drop trajectory calculations[11] were undertaken to ascertain the area and rate of water impingement on the NACA 0012 airfoil for which test data were obtained.

Some results of the trajectory calculations are presented in Fig. 9, which shows the area and rate of water impingement as a function of drop diameter. Area

values are in per cent $s/c$ ($s$ is chordwise distance along surface of airfoil measured from stagnation point, and $c$ is chord length of airfoil) for 1-ft. span; rates are in pounds per hour, foot span for one side of the airfoil. The rate of impingement was calculated for a liquid-water content of 1.0 Gm. per cu.m. A consideration of these curves indicates that a change in design drop diameter from 10 to 20 microns will result in an increase in rate of water impingement of 1.75 lbs. per hour per ft. of span, or an increase of 175 per cent, although the water present per unit volume of cloud has not changed at all. The same increase in drop size will cause an increase in area of impingement from 1.5 to 4 per cent $s/c$. In contrast, the effect of increasing the liquid-water content, for any given drop size, is to proportionally increase the rate of impingement without any change in area of impingement whatsoever. It is interesting to observe from these curves that, for an unprotected airplane having a 40-ft. wing span and 8-ft. chord, the wing would accumulate ice at the rate of nearly 2.0 lbs. per min. in a warm stratus cloud whose liquid-water content was 0.8 Gm. per cu.m. and drop diameter was 15 microns.

In selecting values of drop size, liquid-water content, temperature, and altitude for the design of thermal ice-prevention equipment, a combination of these variables normally occurring in nature should be chosen so as to require the highest rate of heating. Fortunately, in making such a selection, the meteorological research shows that the existence of extremely large drops is generally accompanied by a small concentration of liquid water.

The foregoing discussion has dealt with the factors concerned in the design of a heated wing, and, although these factors have not been presented here in the form of a specific design procedure, it can be stated that the principles of wing thermal ice prevention are now sufficiently well understood to allow wing thermal systems to be based upon specified icing conditions. For a detailed analysis of the procedure for designing a heated wing upon specified icing conditions see reference 10.

*Windshields.*—The main objective of the windshield heat-transfer research was, as in the case of wing and empennage sections, to establish a fundamental procedure for calculating heat requirements in specified icing conditions. A criterion for desirable performance of a windshield ice-prevention system is one that will permit unimpaired vision through the entire windshield area at all times.

For the design of windshield ice-prevention systems on a fundamental basis, reference 12 shows that the same meteorological and heat-transfer parameters are involved as in wing thermal-system design. However, results of windshield ice-prevention tests have shown that it is unnecessary to evaporate all impinging water to meet the design criterion. The reason for this is that water not evaporated in the heated region may be permitted to run back over the fuselage without deleterious effects. This is in contrast to the requirement for wings, where water running back aft of the heated region can cause malperformance of the airplane.

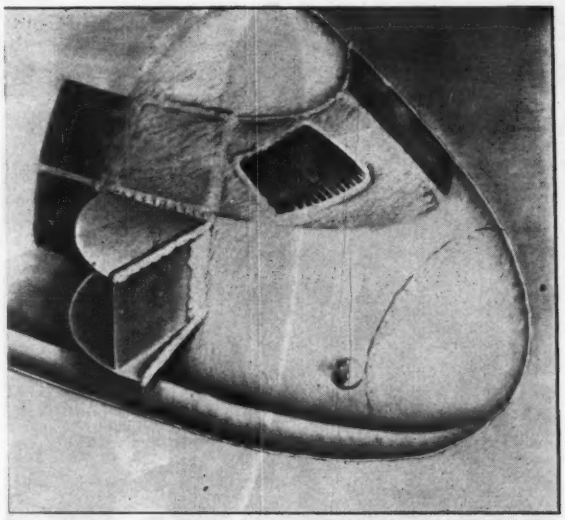


FIG. 10. Sketch based on photographs and flight engineer's notes of an ice accretion obtained on the nose and windshields of the C-46 airplane.

Other observations made with the test windshields have emphasized the important role of drop size in determining heat requirements for ice prevention. During icing flights in which drop diameters as high as 30 microns were experienced, ice was observed to form on the flat-plate windshield when it would not form on the faired-in windshields. This occurrence results from the fact that, for such drop sizes, the faired-in windshields were outside the region of drop impingement. The flat-plate windshield changed the airflow more abruptly than did the fuselage for the faired-in windshield, and, as a result, water droplets impinged upon the flat-plate windshield instead of passing around it. From the foregoing discussion, it should not be concluded that windshield ice formation always can be avoided by use of a faired-in windshield, although it is admitted that a judicious location of a faired-in windshield will reduce the number of cases of ice formation which will ever be incurred.

Interesting observations were also made concerning the comparative amounts of heat required to prevent ice by the various windshield heating systems. One of the most outstanding of these observations was made during a flight in an alto-stratus cloud with large drop diameters (20 to 50 microns). The icing characteristics of the various windshields are illustrated in Fig. 10. For this condition, liquid-water content ranged from 0.15 to 0.3 Gm. per cu.m., the temperature was approximately 19°F., and the true air speed of the airplane was about 160 m.p.h. Because only a few of the larger drops would impinge upon the faired-in windshields, the electrically heated section of the faired-in windshield could be kept clear by a heat supply of only 525 B.t.u. per hour, sq.ft. For the flat-plate windshield, on the other hand, 1,205 B.t.u. per

FIG. 11. Opaque ice formation on propeller blades, obtained on a flight through cumulus clouds.

hour, sq.ft., proved to be inadequate for comparable protection. This was because the flat-plate panel had a higher drop-collection effectiveness. The hot-air-jet method of externally heating the windshield proved inefficient, as approximately 10,000 B.t.u. per hour, sq.ft., were required to prevent ice. Only when heat from exhaust gas would normally go to waste does it appear that use of a hot-air-jet system could ever be justified. Detailed information regarding the computation of windshield-heating requirements will be found in reference 12.

*Propellers.*—Since the electrically heated propeller-blade shoes were intended only for providing protection from ice formations on the propeller blades during the flight tests, no fundamental heat-transfer tests were conducted with the propeller shoes. At times, however, the propeller blades were permitted to accumulate ice formations.

An example of an ice formation that occurred on the propeller blades at a low temperature (−6°F.) is shown in Fig. 11. The ice formation shown in this figure is an opaque type with heavily embedded light hail and snow pellets and demonstrates that propeller-blade protection should extend to nearly the tips of the blades. When ice formations break off asymmetrically, as in Fig. 11, noticeable engine vibration can result. Even ice on the propeller hub can be a hazard. In one instance, ice thrown from the hub on the left propeller was intercepted by a blade cuff, causing the damage along the leading edge shown in Fig. 12. At the time this damage to the cuff occurred, a window located approximately 3 ft. forward of the propeller disc was broken by ice.

### *Operation of the Wing Empennage Thermal Ice-Prevention Equipment*

The general performance of the thermal ice-prevention system in the wings and empennage of the C-46 airplane during the flight tests proved that the installation, which had been previously tested in the layer-type clouds predominating in the Minneapolis, Minn., area, was capable of extended flight in cumulus clouds. Although only a few measurements of the meteorological conditions were made in previous C-46 tests at Minneapolis, it is believed that some of the icing conditions encountered during the 1946–1947 tests were more severe than any previously experienced. With the exception of a few cases of runback formed by heating the wings after ice had formed on the leading edge, the heated surfaces were always maintained clear of ice. The airplane was considered by the pilot, one of the foremost pilots of United Airlines, to be capable of flight for an unlimited period in any of the icing conditions experienced in these tests. Although the efficient design of future thermal ice-prevention systems now can be assured through a fundamental understanding of the meteorological and heat-transfer factors concerned, the general soundness of the empirical dry-air design procedure used for the C-46 airplane has been established.

FIG. 12. Damage to a propeller blade cuff as a result of ice being thrown from the propeller hub.

## Conclusion

In conclusion, it can be stated that the research information obtained in these flight tests should prove of considerable aid in the development of thermal ice-prevention equipment for all-weather flight operations. In addition, the practicability and reliability of a thermal ice-prevention system in a typical transport airplane has been established.

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*Summaries of current papers received for publication or presentation at I. A. S. meetings*

*Many of these papers, after being processed by the Editorial Committee in the usual manner, will appear in full in later issues of the* JOURNAL *or* REVIEW.

**Preprints of these papers are not available at this time.**

## A Numerical-Graphical Method of Characteristics for Axially Symmetric Isentropic Flow*

*By*

**Lester L. Cronvich**

*The Johns Hopkins University*

A graphical-numerical method of characteristics, based on the Tollmien method, is developed for axially symmetric isentropic flow problems. Complete rules of procedure are presented for the application of the method. Similar methods have been given by Ferrari and Ferri. As an illustration, the flow around a conical-nosed body is calculated. In this problem a procedure is given for approximating the curved shock wave, assuming constant entropy behind the shock wave. A procedure for advancing from a curved sonic line is appended.

* To appear in a forthcoming issue of the JOURNAL OF THE AERONAUTICAL SCIENCES.

## Warping and Shear Lag in Closed Cylindrical Shells*

*By*

**Leon Beskin**

*Navy Department*

The state of stress in thin-walled closed cylindrical shells is determined in the neighborhood of sections with concentrated loads or sections corresponding to discontinuities of section properties, such as fixed ends. A method of successive approximations is developed, using the conventional beam formulas as the first approximation, and the second approximation, considered as a correction to the first, is determined and examined in detail in the cases of torsion and bending.

This correction may be regarded as a type of stress distribution having the property of producing no section warping to a greater degree of accuracy than the conventional solution. Superposition of the two solutions gives the possibility of writing arbitrary warping conditions at given sections. For instance, at a fully restrained section (built-in cantilever), the nonwarping solution replaces the conventional one, but, along the beam, the nonwarping solution damps out, following an exponential law, and is replaced by the conventional solution. In the case of a section with a concentrated load, it is possible to write that the mean warping due to the conventional distribution is the same on the two sides of the loaded section, thus defining the portions of the loads taken by each distribution on each side.

A similar method applies to the case of a change of section properties in shear, if the rigidities in shear change in the same ratio at all points of the section. The validity of the method, in the case of structures stiffened by frames, is limited by the fact that the frame spacing is often of the order of, or even larger than, the characteristic length along which the nonwarping solution damps out, while it is assumed that the frames are infinitely closely spaced. However, the fundamental aspects of the phenomenon remain unchanged, and a more complete analysis could be made along the same lines.

* To appear in a forthcoming issue of the JOURNAL OF THE AERONAUTICAL SCIENCES.

## High-Speed Flow Through Cambered Rotating Grids*

*By*

**Frank L. Wattendorf**

*U.S.A.F. Scientific Advisory Board*

In a previous paper, an analysis was given for the ideal performance of rotating blades in curved lattice arrangement. The lattice type of blading represents an approach to higher stage pressures by utilizing blades that are more closely spaced and highly cambered than airfoil theory permits. The blades exert a predominant guiding action on the flow, and the direction of flow relative to the trailing edge of a blade is essentially determined by the angular setting of the trailing edge itself.

For incompressible flow, ideal pressure coefficients based on blade tip speed can be computed as a function of the flow coefficient. Experimental results of several investigators show good comparison with the theory in the neighborhood of the design point. For compressor application, the stage temperature ratio or pressure ratio replaces the pressure coefficient in significance. The temperature ratio can also be expressed in terms of the velocity diagram and Euler's equation.

* To appear in a forthcoming issue of the JOURNAL OF THE AERONAUTICAL SCIENCES.

The present paper shows various configurations of flow diagram which result in considerable increases in the ideal stage pressure ratio, and the following four cases are considered: 1. subsonic flow throughout; 2. subsonic axial flow, subsonic flow in the rotor, supersonic flow in the downstream stator; 3. subsonic axial flow, supersonic flow in rotor and stator; 4. supersonic flow throughout. In all cases considerations are limited to ideal adiabatic flow through curved lattice types of blading.

It is the purpose of this paper to show the large potential increases in ideal stage pressure ratio theoretically possible in axial compressors, with a view toward stimulating experimental investigation of the losses involved, and of possible methods of decreasing these losses. Application would be especially promising for cases where simplicity and compactness outweigh the importance of efficiency.

## Machmeters for High-Speed Flight Research*

By

**Herbert Schaefer**

*Square D Company*

The Machmeter, an instrument designed to indicate the Mach Number at which an aircraft is flying, is being used as a test instrument as well as a flight instrument. The objective of this paper is to give a résumé of the theory and design of various types of Machmeters now in use.

After an explanation of the Mach Number and a brief survey of transonic and supersonic flow conditions, the aerodynamics of the Machmeter is presented. For the supersonic speed, a simplified exact equation is given for the stagnation pressure as a function of the flight Mach Number and the free-stream pressure. Graphs are presented showing the relations of pressure and temperature at the stagnation point vs. the flight Mach Number.

After a short description of the design of a subsonic Machmeter, a more detailed description of the newly developed transonic Machmeter follows, mentioning a number of design details. Then the Mach Number Limit Switch is briefly discussed, followed by a description of the Maximum Allowable Airspeed or Mach Airspeed Indicator, the aerodynamic theory of which is also presented.

* Paper to be presented at the Sixteenth Annual Meeting of the Institute.

## Effects of Cutouts in Semimonocoque Structures*

By

**P. Cicala**

*Politechnico di Torino*

The stress distribution in monocoque structures having cutouts has been previously investigated by several authors under the assumption of rigid frames. This same problem is here dealt with for the circular cylinder reinforced by equal and equally spaced stringers and by equal flexible circular frames (rings). A solution is developed that considers the deflections of the frames according to the theory of curved beams. The results of numerical computations show that the flexibility of the frames considerably influences the stress distribution, producing a marked stress concentration near the cut. A peak in the shear flows, not detected by the previous approximate analyses, appears close beside the opening. The test results obtained by Langhaar and Smith agree with the more accurate theory within the experimental scatter limits.

* Accepted for publication in the JOURNAL.

## Plasticity for the Aerodynamicist*

By

**William Prager**

*Brown University*

With the increasing need for exact methods of stress analysis beyond the elastic range, the interest in the mathematical theory of plasticity is rising steadily. The present paper contains a survey of the classical theory of plasticity (St. Venant-Mises theory) as applied to problems of plane plastic flow. The presentation is kept as elementary as possible, the only prerequisites expected from the reader being a knowledge of strength of materials and the rudiments of the theory of elasticity. The most important classical results, as well as some modern developments, are presented with particular emphasis on the analogies between plasticity and fluid dynamics.

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| 106. | Measurement of Ambient Air Temperature in Flight—W. Lavern Howland, Lockheed Aircraft Corporation. 13 pages; 5 illus. (Ozalid.) | $0.50* |

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## Aerodynamics

### AERODYNAMIC LOADS

**Tests of $^1/_{16}$-Scale Wind-Tunnel Model of Consolidated-Vultee XP-81 (Five-Foot Wind Tunnel Test No. 542).** D. W. Young and J. B. Trenholm. *U.S., Army Air Forces, Technical Report No. 5566*, April 7, 1947. 46 pp., illus.

**The Simple Aerodynamics of Gusts.** C. J. O. Moorhouse. *Aeronautics*, Vol. 17, No. 3, October, 1947, pp. 36, 37, figs. A brief review of the effects of gusts on lift, on determination of the load factor, and on minimum speed.

### CONTROL SURFACES & AUXILIARY DEVICES

**Assisted Control. I—Spring Tabs (Stuurkrachtversterkers. I—Veerbalansvlakken).** A. J. Marx and J. Buhrman. *Netherlands, Nationaal Luchtvaatrlaboratorium, Rapport Nr. V.1398*, February 17, 1947. 20 pp., diagrs. (In Dutch, with English summary and definitions of symbols.)

An analysis of the action of spring tabs in the reduction of the stick forces required to operate the controls of heavy, high-speed aircraft. The spring-tab design described employs a spiral spring. The effectiveness of the spring force varies with the deflection of the control surface between zero and infinity. The boost ratio of the arrangement is such that the control varies in its action from one that is normally geared to one that incorporates an infinitely stiff spring.

**High-Speed Wind-Tunnel Investigation of High Lift and Aileron-Control Characteristics of an NACA 65-210 Semispan Wing.** Jack Fischel and Leslie E. Schneiter. *U.S., N.A.C.A., Technical Note No. 1473*, November, 1947. 32 pp., illus. 7 references.

Results and discussion of high-lift and lateral-control investigation of a thin low-drag semispan wing variously equipped with a 25 per cent chord full-span slotted flap and a 38 per cent semispan 20 per cent chord sealed plain straight-sided aileron. Lift data were obtained with a flap retracted and deflected; lift and lateral-control data were obtained through a large angle-of-attack range and at Mach Numbers up to 0.71.

**Experiments on the Effect of Transition on Control Characteristics, with a Note on the Use of Transition Wires.** L. W. Bryant and A. S. Batson. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2164*, November, 1944. 21 pp., figs. 6 references. British Information Services, New York. $1.20.

A study to determine the magnitude of scale effect on controls. In order to distinguish that portion of the effect which is the true effect of the increased Reynolds Number and that which arises from the movement of the point of transition, the effect of the movement of transition on controls was investigated in low-speed wind tunnels with two-dimensional section tests. The results indicated a practical method of applying model data to full-scale aircraft if the transition movements on the full-scale surface are known.

**Wind-Tunnel Investigation of Ailerons on a Low-Drag Airfoil. I—The Effect of Aileron Profile.** Robert M. Crane and Ralph W. Holtzclaw. *U.S., N.A.C.A., Advance Confidential Report No. 4A14 (Wartime Report No. A-55)*, January, 1944. 64 pp., illus. 5 references. (Cf. AER 12/47:37.)

**Wind-Tunnel Data on the Aerodynamic Characteristics of Airplane Control Surfaces.** Richard I. Sears. *U.S., N.A.C.A., Advance Confidential Report No. 3L08 (Wartime Report No. L-663)*, December, 1943. 316 pp., illus. 47 references.

A collection of wind-tunnel data on the lift and hinge-moment characteristics of various types of airplane control surfaces. The control surfaces are mainly of the wide-chord type used for elevators and rudders. They include surfaces of airfoil sections, both without aerodynamic balance and with balances of the overhang (inset hinge), and horn, internal, and beveled-trailing-edge types. Section data is obtained for flaps in conjunction with NACA airfoils 0009, 0015, and 66-009. Finite-span aerodynamic-balance data are also given for the various types of flaps and balances. Tables I through III gives the type of flap section, airfoil designation, type of balance and gap, and the graphs in which the data are to be found. Each graph is keyed to a bibliography that lists the original reports in which the data were published. A limited discussion of the characteristics of several types of


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balanced control surfaces and an outline of the method of using the section data for the computation of the aerodynamic characteristics of finite control surfaces are included.

## FLUID FLOW

**Approximations Involved in the Linear Differential Equation for Compressible Flow.** H. W. Sibert. *Journal of the Aeronautical Sciences*, Vol. 14, No. 12, December 1947, pp. 680–681. (Cf. AER 7/47:29.)

**On the One-Dimensional Theory of Steady Compressible Fluid Flow in Ducts with Friction and Heat Addition.** Bruce L. Hicks, Donald J. Montgomery, and Robert H. Wasserman. *Journal of Applied Physics*, Vol. 18, No. 10, October, 1947, pp. 891–902, figs. 25 references. (Cf. AER 10/47:33.)

The one-dimensional treatment of steady flow is generalized to include the simultaneous effects of heat addition, friction, and area change upon a compressible fluid. The one-dimensional differential equations that are obtained are identical with the equations previously used by other investigators in less general cases. Generalized conversion equations have been derived to provide a complete and logical basis for the theory that is intended to serve as a foundation for calculation of all types of shockless flow to which the one-dimensional approximation is applicable. A transformation of the generalized relations is performed by introducing the square of the local Mach Number as a basic variable. The equations obtained contain only this variable and pressure and temperature. An examination of values of $M$ from zero to infinity shows that the treatment is applicable both to subsonic and supersonic flow. In the general case the differential equations do not permit of formal integration but, since they are of the first order, they can be handled numerically. A solution of the system is shown to exist, except at $M = 1$, when special conditions must be fulfilled. The solution permits the determination of the direction of change of the flow variables without integration.

**Abrupt Energy Transformation in Flowing Gases.** N. P. Bailey. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 7, October, 1947, pp. 749–757, illus., figs., Discussion, pp. 758–763.

After setting up the basic equations of energy, flow, and acceleration, theoretical and actual plane compression shocks in tubes are compared. By making the single-plane-angle shock a special case of plane shock, curves are developed for solving numerical cases. Although most angle shocks encountered in engineering are nondimensional, the complications of three-dimensional theory can be avoided by the use of the simple theory of single-plane shocks. Although no complete explanation exists for thermocouple readings in excess of the total gas temperature in such high-temperature shocks in nozzle and orifice discharges and their traverses through shock diamonds, their existence is established. As a last case of abrupt energy transformation in gas streams, tests of combustion with flow in a constant-area tube are commented upon. Experiment and analysis agree that the assumptions of constant-area flow and steady or continuous flow do not appear to be simultaneously tenable when combustion is present.

**The Flow of Gases at Sonic and Supersonic Speeds.** G. A. Hankins and W. F. Cope. *Institution of Mechanical Engineers, Proceedings*, Vol. 155, War Emergency Issue No. 23, *Applied Mechanics*, 1946, pp. 401–408, illus., figs., Discussion, pp. 409–416. 22 references.

At the speed of sound and at higher speeds the gas flow becomes compressible and is characterized by shock waves, which are planes through which the gas passes and in which it undergoes an abrupt change of state. These effects are observed not only in flow in which the gas is disturbed by the presence of a foreign body, but also in internal flow of a gas through a duct of variable dimensions. Methods that are used to measure the speed of air in a wind tunnel and boundary-layer research are reviewed. The paper attempts to integrate the experiences on this subject which are common to the aerodynamicist, the ballistician, and the turbine engineer.

**The Separation of Flow Due to Compressibility Shock.** A. Weise. (*Technische Berichte, Band 10, Heft 2*, 1943, pp. 59–61.) *U.S., N.A.C.A., Technical Memorandum No. 1152*, July, 1947. 9 pp., illus.

An analysis of the production of branched compressibility shocks and their relation to boundary-layer separation. Schlieren photographs show the results obtained by the use of suction slots to remove the boundary layer in a divergent channel. Proper design stabilizes the position of the shock and eliminates the losses that may be attributed to boundary-layer separation.

## FLUTTER & VIBRATION

**Free Vibrations of Sweptback Wing.** Adam T. Zahorski. *Journal of the Aeronautical Sciences*, Vol. 14, No. 12, December, 1947, pp. 683–692, illus. 6 references. (Cf. AER 7/47:28.)

**Aerodynamic Forces on Wings in Simple Harmonic Motion.** W. Prichard Jones. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2026*, February 20, 1945. 28 pp., figs. 17 references. British Information Services, New York. $1.50.

The method used in *R & M 2145* for the calculation of the pressure distribution on a wing of any plan form in steady motion is extended to include oscillatory motion. The flow around the wing is reproduced by a linear combination of simple doublet distributions over the wing area and the wake. A simple combination of simple doublet distributions, the velocities of which can be calculated exactly, can be determined by collocation to satisfy the boundary conditions for any mode of oscillation. The $n$ complex simultaneous equations, which must be solved if the condition for the tangential flow is to be satisfied at $n$ points on the wing, are laborious. An approximate method that reduces the number of equations to be solved is outlined and used to calculate the aerodynamic derivative coefficients for tapered wings. Satisfactory agreement between theory and experiment is obtained.

**Effect of Finite Span on the Airload Distributions for Oscillating Wings. II—Methods of Calculation and Examples of Application.** Eric Reissner and John E. Stevens. *U.S., N.A.C.A., Technical Note No. 1195*, October, 1947. 131 pp., figs. 8 references.

The significance of the aerodynamic-span effect decreases as the frequency of oscillation of a wing increases. In order to determine the range of frequency in which this effect is appreciable, the two-dimensional lifting-line theory, modified by a correction term for three-dimensionality, is used to calculate the behavior of wings of aspect ratio 3 and 6 and of rectangular or elliptical plan form. This effect might not have to be considered when the aspect ratio is 6 and the reduced frequency is greater than 1. When the aspect ratio is 3, there is no need to consider it when the reduced frequency is greater than 2. Important corrections are necessary when the reduced frequency is less than 0.5 and the aspect ratio is equal to 6, and when the reduced frequency is less than 1 and the aspect ratio is 3. Calculations show that the aerodynamic-span effect is appreciably less for hinge-moment distributions. Even though the theory does not fully account for the effect of finite span when this problem arises, corrections are obtained which are in the right direction and are applicable. Two examples are given for the application of this correction for finite span to flutter calculations, one for a wing and the other for a tail surface.

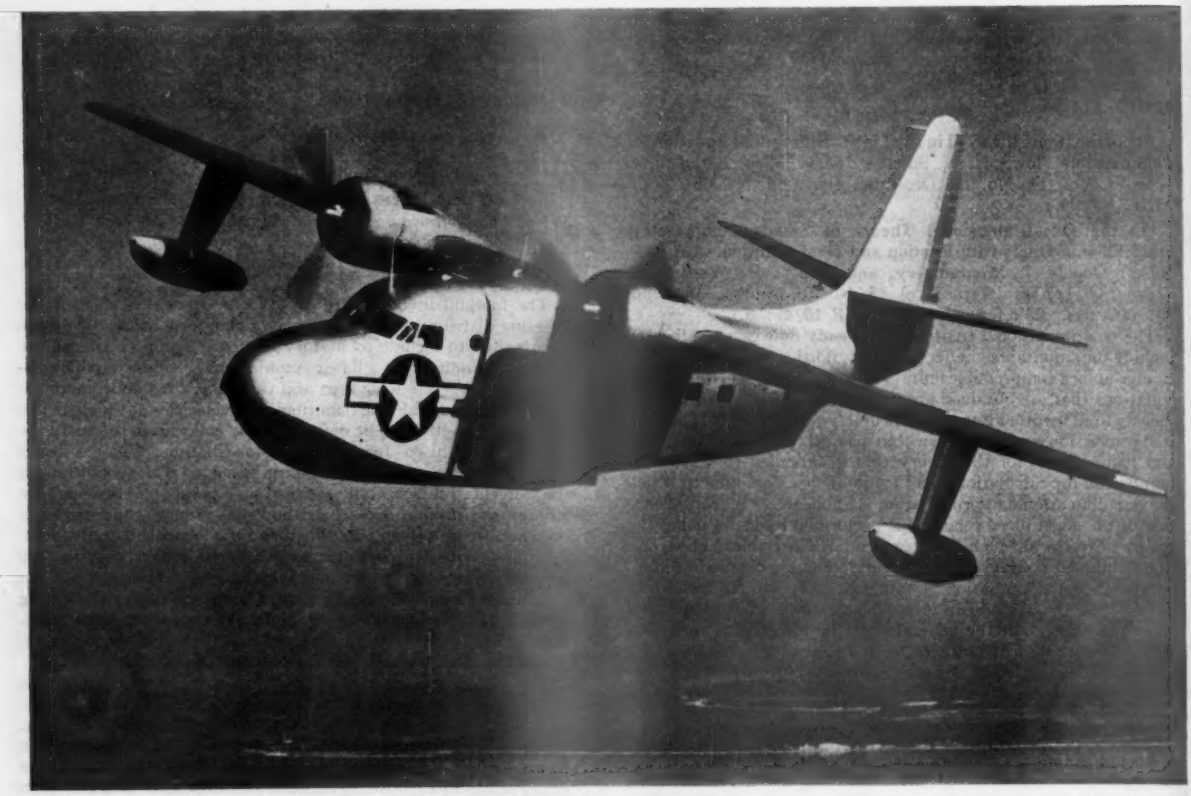
**Model Experiments on the Effect of Wing Engines on the Natural Frequencies and Modes of Vibration of Wings. I.** J. Hanson and E. Warlow-Davies. **II.** J. Taylor. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2128*, April, 1939. 30 pp., illus. 4 references. British Information Services, New York. $1.65.

An idealized elastic system was set up to represent a full-scale, small-aspect-ratio wing. The frequencies and modes showed gradual changes with variation of engine offset and engine mass. Within the practical range of offset and mass the engine acted as an effective root of a torsional motion that is "dangerous" in the flutter sense and tends to raise the flutter speed of the wing. A system representative of a large-aspect-ratio wing gave similar results, but the modes of vibration were not so clearly defined as with the low-aspect-ratio model, which made the prediction of "safe" or "dangerous" flutter modes less certain. The third resonance may possibly prove dangerous in the flutter sense because in this range the nodal line for this mode passes approximately through the wing engine and crosses the flexural axis at about 0.75 semispan.

## PERFORMANCE

**A Method for Estimating Gas Turbine-Jet Performance.** Robert E. Hage. *U.S., Army Air Forces, Technical Report No. 5193*, March 8, 1945. 47 pp., figs. 3 references.

The conventional power-required power-available curves for an airplane in uniform level flight at various speeds which are used to



*Official U.S. Navy Photograph*

**Navy's newest amphibian, the Grumman XJR2F Albatross, is designed for rough-water operation on the open sea. Plane can carry 14 passengers and has a maximum speed of 270 m.p.h.**

compute the performance of internal combustion engines are modified to show the thrust available and the thrust required of a turbine-jet airplane. In order to shorten the computations, the thrust-required curve is generalized so that one curve is applicable for all altitudes and any combination of airplane characteristics. The method of determining maximum speed, rate of climb, range endurance, and take-off distance is explained and exemplified by a sample performance computation.

**Generalized Performance Selection Charts for Single-Engine Pursuit Airplanes.** H. Reese Ivey, George W. Stickle, and Maurice J. Brevoort. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-673)*, February, 1943. 75 pp., figs. 10 references.

**Comparison Between Actual and Calculated Performance of Me 262 Jet Fighter Bomber.** Horn. (*Messerschmitt A.G.*, January, 1944.) *U.S., Air Force, Translation No. F-TS-3403-RE*, October, 1947. 11 pp., figs.

Flight tests confirmed the validity of the polars used to compute the performance of the Me 262 for altitudes up to 5 km. These graphs do not take compressibility into account. Compressibility effects do appear but are not sufficient to exceed the safety margin included in the calculations for the polars.

## STABILITY & CONTROLLABILITY

**A Continuation of Longitudinal Stability and Control Analysis. I—General Theory.** S. B. Gates and H. M. Lyon. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2027*, February, 1944. 34 pp., figs. British Information Services, New York. $1.80. (Cf. AER 12/47:47.)

A mathematical theory of stability and control. It includes an analysis of the effects of structural distortion and the effects of the slipstream. It is a first-order theory, and its applicability at high Mach Numbers beyond the shock stall is doubtful. Stability and handling qualities are mainly determined by the value of the static margin and of the maneuver margin. In actual flight-testing maneuverability criteria, stick force or travel per $g$, which is observed in the response in a pull-out from a dive, is shown to be justifiable, since speed may be assumed to be constant during the maneuver. In cases, however, where the maneuver margin is small, the criteria based on steady acceleration are of little practical significance because of the excessive length of time necessary to reach a steady condition in an actual pull-out. For these cases a revised criterion is needed, based possibly on a reasonable time interval.

**An Analysis of Static Longitudinal Stability in Relation to Trim and Control Force.** S. B. Gates. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2132*, April, 1939. 29 pp., figs. 5 references. British Information Services, New York. $1.65.

**I.** The most practical measure of static longitudinal stability is given by the range of control angles to trim and by the magnitude of the control force to change speed from a trimmed position. This criterion is worked out for the gliding condition with particular attention to the case in which there is a large center of gravity range. **II.** The experimental data obtained by Bryant in the study of slipstream distortion in a typical twin-engined design is used to develop a similar analysis of powered flight.

## WINGS, AIRFOILS, & EMPENNAGE

**Wing Body Interference at Supersonic Speeds.** S. Kirkby and A. Robinson. *College of Aeronautics, Cranfield, England, Report No. 7*, April, 1947. 16 pp., figs. 3 references.

In order to estimate the increment in wing lift due to the presence of a body, the body is represented by a cone travelling vertex foremost. The velocity field caused by the cone is considered to be generated by an equivalent doublet distribution along the axis of the cone. The upwash velocity is evaluated along the mid-chord line of the wing, and, by application of Ackeret's theory, an estimate is obtained of the increment in wing lift due to body interference. A comparison with the exact (linearized) theory

shows that for all practical purposes it is permissible to use Ackeret's theory to calculate the wing lift increment.

**The Effect of Sweepback of Delta Wings on the Performance of an Aircraft at Supersonic Speeds.** A. Robinson and F. T. Davies. *College of Aeronautics, Cranfield, England, Report No. 6*, March, 1947. 17 pp., figs. 3 references.

An analysis of the variation of lift and drag at supersonic speeds with variations in sweepback. Sweepback or sweep forward of the trailing edge is irrelevant in comparison with sweepback of the leading edge. As the sweepback changes, the trends of variation of the induced drag are opposed to those of wave drag. The lower the speed and the higher the altitude, the more important the induced drag. Sweepback is, therefore, not uniformly beneficial. The optimum sweepback depends on the design speed and the design altitude of the aircraft.

**Theoretical Supersonic Wave Drag of Untapered Sweptback and Rectangular Wings at Zero Lift.** Sidney M. Harmon. *U.S., N.A.C.A., Technical Note No. 1449*, October, 1947. 43 pp., figs. 5 references. (Cf. AER 9/47:34.)

An extension of the theoretical investigation of a series of wings that have thin symmetrical biconvex parabolic-arc sections, as originally presented in *N.A.C.A. Technical Note No. 1319*. The range of Mach Numbers is increased to include those that bring the Mach line behind the wing leading edge. A single chart of the results permits the direct determination of the wave drag for this family of wings over an extensive range of sweepback angle, Mach Number, aspect ratio, and thickness ratio. The results obtained for the total wave drag of the sweptback wings are applicable to the same family of wings having a corresponding degree of sweep forward. When the Mach line lies behind the wing leading edge, the wave-drag coefficients of the sweptback and rectangular wings reach maximum values at certain limiting aspect ratios and remain constant for all aspect ratios greater than these limits. The variation of wing wave-drag coefficient with Mach Number over the complete range of supersonic Mach Numbers becomes less pronounced with decreasing aspect ratio. Sweepback obtained by rotating the wing panels rearward can give appreciable reductions in wing wave-drag coefficients at all supersonic speeds.

**The Effect of Boundary-Layer Thickness on the Normal Force Distribution of Aerofoils, with Particular Reference to Control Problems.** A. S. Batson and J. H. Preston. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2008*, April, 1942. 46 pp., illus. 34 references. British Information Services, New York. $3.00.

The use of trailing-edge strips and the variations in thickness of the boundary layer which are caused by changes in the position of the transition point produce a marked effect on the hinge moment of control surfaces. The action of trailing-edge strips is caused largely by alteration of the circulation about the airfoil and the corresponding change in the slope of the lift curve. The hinge moment is found to be approximately independent of the airfoil thickness, Reynolds Number, and the position of the transition point. It thus appears possible to obtain an estimate of the full-scale hinge moment from the corresponding lift curve. Experiments made with a pitot traverse just behind the trailing edge show that for a particular airfoil, the boundary-layer thickness is a function only of the drag of a surface and is independent of the particular combinations of incidence, Reynolds Number, and the conditions in the boundary layer. Smoke experiments gave a visual determination of the transition region. The mean transition point obtained upon application of Squire and Young's method gives drag values that are in reasonable agreement with those measured by the pitot-traverse method.

**Profile Drag Measurements on a Spitfire Wing in Flight at High Speeds.** W. A. Mair and W. J. Charnley. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2159*, June, 1945. 14 pp., diagrs. 8 references. British Information Services, New York. $0.90.

Wake transverse measurements for the determination of profile drag were made in flight on a Spitfire wing at Mach Numbers up to 0.89. Because of experimental difficulties and the large extent of the shock waves, the part of the drag due to direct shock-wave loss was not determined; the remainder of the drag was determined approximately. Probable values of the shock-wave drag and the extent of the shock waves and possible alternative methods of measuring profile drag in flight at high speeds are discussed.

**On Some Boundary Value Problems in the Theory of the Non-Uniform Supersonic Motion of an Aerofoil.** Olga Todd. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2141*, September, 1945. 13 pp., 8 references. British Information Services, New York. $0.75.

A solution of the boundary value of the linear partial differential equation of the second order, which was obtained by Possio for the nonuniform motion of airfoils, requires the solution of an equation of the hyperbolic type. The method used by Possio is modified and his results are derived more rigorously. These results are compared with those obtained by Temple, Jahn, and von Borbély.

**A Theoretical Discussion of Wings with Leading-Edge Suction.** M. J. Lighthill. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2162*, May, 1945. 9 pp., figs. 2 references. British Information Services, New York. $0.60.

It appears theoretically possible to design airfoils that will not have any discontinuity in velocity near the leading edge. In such a design, one suction slot could be used both to remove the boundary layer and also to receive a considerable quantity of free air from outside the boundary layer, so as to eliminate the large adverse pressure gradient behind the slot.

**Reduction of Airfoil Resistance by Use of "Drawn-In" Profiles.** Ernst von Lössl. *U.S., Field Information Agency, Technical, Final Report No. 1087*, March 3, 1947. 9 pp., diagrs. 3 references. British Information Services, New York. $0.35. (In German.)

The variation of frictional force on the surface of an airfoil or other streamlined body depends on the increase in the so-called boundary layer and increases as the boundary layer decreases in thickness, and particularly so as the transition from laminar to turbulent flow occurs. The production of a turbulent boundary layer can be prevented or controlled in several ways. One of these is to introduce a local change in the airfoil profile so as to give a pressure increase in the surrounding stream in the region where the transition from laminar to turbulent flow would otherwise occur. Theoretical and experimental results of this method of reducing frictional drag are presented.

**Experiments with a Suction Wing.** C. Schrenk. (*Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 22, No. 9, May 15, 1931, pp. 259–264.) *U.S., Army Air Forces, Library (Washington), Translation No. 444*, February 15, 1946. 19 pp. 5 references.

The results of wind-tunnel experiments on the profile characteristics of a wing employing suction to remove the boundary layer. Wind-tunnel balances were used to measure the forces acting on the wing and from these observations the character of the flow along the wing was calculated. Results confirmed theoretical calculations of boundary layer and its transition to turbulent flow and indicated the practicability of using suction boundary-layer removal to improve the flow characteristics of aerodynamic structures.

## Airplane Design & Description

**Analysis for Optimum Transport Airplane Configuration.** Philip A. Colman. *Aeronautical Engineering Review*, Vol. 6, No. 12, December, 1947, pp. 20–27, figs. (Cf. AER 9/47:29.)

**A Survey of the Technical Problems of the Design of Naval Aircraft.** W. S. Farren. *Royal Aeronautical Society, Journal*, Vol. 51, No. 442, October, 1947, pp. 787–796, figs., Discussion, pp. 796–799. (Cf. AER 9/47:41.)

The long range required of naval aircraft and the additional structural weight imposed by wing-folding mechanisms and high shock-resistant landing gear place restrictions on design which tend to make naval aircraft inferior to land-based models. The maximum utilization of the facilities of the carrier which would make possible the use of aircraft without landing gear, the use of aerodynamic devices to provide high lift during the landing approach, and the development of high-efficiency power plants, can overcome these limitations and result in a naval aircraft equal to, or superior to, the land-based type.

**All Day Discussion on Naval Aircraft; Final Discussion and Summing-Up.** *Royal Aeronautical Society, Journal*, Vol. 51, No. 442, October, 1947, pp. 850–862.

**Developments in High-Speed Aircraft.** H. E. Heinemann. *Mechanical Engineering*, Vol. 69, No. 10, October, 1947, pp. 805–812, illus. (See AER 7/47:39.)

**That New Ideal; Some Comments on Sir Roy Fedden's Suggested Executive Aircraft.** C. A. H. Pollitt. *Flight*, Vol. 52, No.

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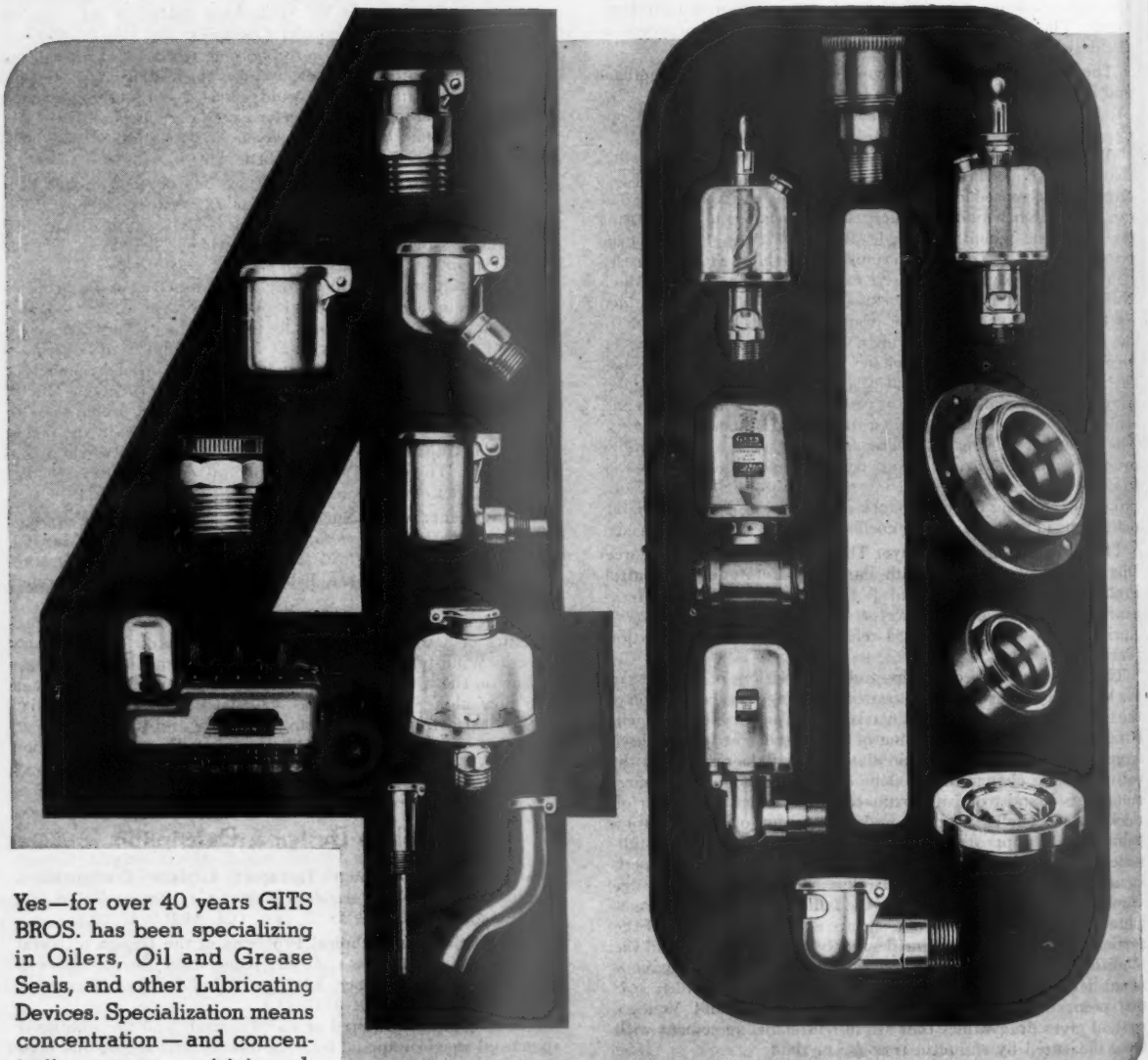

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2025, October 16, 1947, pp. 439, 440, diagrs. (Cf. AER 12/47: 39.)

The proposed design fails to fulfill its own specifications for safety and comfort. The extreme specialization of the craft limits its market to such an extent that it could not be produced economically.

**The Future of Personal Aircraft.** T. P. Wright. *Southern Flight*, Vol. 28, No. 4, October, 1947, pp. 10, 11, 45–48, illus.

**Liberty for the Ultra-Light.** A. R. Weyl. *Aeronautics*, Vol. 17, No. 3, October, 1947, pp. 48–51.

Suggestions for the design and legal regulation of amateur-built personal airplanes of small size with horsepower ratings not exceeding 60 hp. for the single-place and 90 hp. for the two-place types.

**Control-Motion Studies of the PBM-3 Flying Boat in Abrupt Pull-Ups.** Henry A. Pearson and Leland K. Smull. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-557)*, November, 1942. 39 pp., illus. 2 references.

**Pressurisation; Some Problems of Cabin Air Control; and Modern Trends in Their Solution.** W. M. Widgery. *Flight*, Vol. 52, No. 2025, October 16, 1947, pp. 435, 436, illus. (Extended abstract of a paper.)

**Fine Points of Sealing Pressurized Plane; Potential Leak Sounces Identified; Role of Rivets Evaluated; Sealant Materials Analyzed.** *Aviation Week*, Vol. 47, No. 19, November 10, 1947, pp. 34, 36, diagrs.

**Metallurgical and Chemical Examination of a Japanese Landing Gear and Wheel.** L. H. Grenell, J. R. Cady, and others. (U.S., Office of Scientific Research and Development, National Defense Research Committee.) *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./1479*, June 29, 1944. 13 pp., illus. British Information Services, New York. $0.90. Physical and chemical properties of the alloys, metals, and plastics; and the methods used in the fabrication of the components.

**Skis Broaden Aircraft Utility.** Arthur A. Bursch. *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 46, 47, 116, illus. General design principles and practice of Federal Aircraft Works in manufacturing skis for civil and military use.

**Air Race Classic.** Robert McLarren. *Automotive Industries*, Vol. 97, No. 6, September 15, 1947, pp. 42–44, 78, 80, 82, illus.

The contestants entered in the 1947 National Air Races did little air frame or engine design modification. Emphasis was placed on obtaining higher speed by water injection and special fuel blends. Contestants for the Goodyear Trophy produced some new designs in light planes.

**New Aircraft: Czechoslovakia.** *Aviation Week*, Vol. 47, No. 19, November 10, 1947, pp. 50, 53, 54, illus.

Aero 45 five-passenger, two-engined transport; Hodek HK 101 2-place sports airplane; Praga E211 2-engined pusher airplane for taxi or private use; Sokol 3-place single-engined low-wing monoplane; and Praga Air Baby personal plane are covered.

**Radlett Review.** *The Aeroplane Spotter*, Vol. 8, No. 195, September 6, 1947, pp. 196–200, illus.

Illustrations of the prototypes shown at the annual Flying Display and Exhibition of the Society of British Aircraft Constructors. A table showing power-plant, dimensional, and performance specifications of 156 British aircraft includes both aircraft in current use and prototypes under development.

**Sketched at Radlett.** *The Aeroplane*, Vol. 73, No. 1894, September 26, 1947, pp. 442–444, 446, illus.

Drawings of: the drive for the rotors and antitorque propeller of the Fairey Gyrodyne; the main undercarriage leg of the Bristol Brabazon; the Fowler split-type flap of the Scottish Aviation A.4/45; the outswept canopy, air scoop, and undercarriage strut of the Heston A.2/45; and the wing structure and the deicing equipment of the General Aircraft Universal Transport prototype.

**A View of France. II—Diary of a Ten-Day Tour of Industrial, Scientific and Military Centres.** H. F. King. *Flight*, Vol. 52, No. 2025, October 16, 1947, pp. 441–445, illus. A brief sketch of engine research at the Arsenal del'Aéronautique at Chatillon-sous-Bagneaux and the research aircraft being developed at Villacoublay.

**British Aircraft; Current Designs for Civil and Military Uses; Products of 27 Firms.** *Flight*, Vol. 52, No. 2020, September 11, 1947, pp. 277–288, illus.

**British Aircraft Industry Review.** *The Aeroplane*, Vol. 73, No. 1891, September 5, 1947, pp. 289–304, 315–324, illus.

**Radlett; Eighth S.B.A.C. Flying Display and Exhibition.** *Flight*, Vol. 52, No. 2021, September 18, 1947, pp. 317–332, illus.

**Radlett Releases; Trainers, Private-Owner Types and Helicopters.** *Flight*, Vol. 52, No. 2021, September 18, 1947, pp. 307–310, illus.

**The Brussels Aero Show.** *The Aeroplane*, Vol. 73, No. 1892, September, 12, 1947, pp. 367–369, illus.

**Flying the Novel Beech Twin-Quad (Model 34 20-Passenger Short-Haul Air Transport).** *Aviation Week*, Vol. 47, No. 19, November 10, 1947, p. 13, illus.

**Research Aircraft.** P. B. Klein. *Mechanical Engineering*, Vol. 69, No. 10, October, 1947, pp. 813–819, illus.

A description of the overall specifications of the Bell XS-1 which was designed to fly at transonic speeds. The power plant consists of four rocket engines that burn liquid oxygen and alcohol. The XS-1 was air-launched and attained stable flight at a speed somewhat over 0.80 Mach. Internal arrangement, pressurized fuel system, and design problems are described.

**Design for Jet (The Boeing XB-47 Stratojet.)** *Southern Flight*, Vol. 28, No. 4, October, 1947, p. 17, illus.

**XL-15 Demonstrates Its Versatility; Boeing Liaison Plane Has a Variety of Uses in Varied Climes.** *Aviation Week*, Vol. 47, No. 20, November 17, 1947, pp. 22, illus.

**The Brabazon; Naming Ceremony at Filton of the Bristol 167; Another Step Forward in a Great Venture.** *Flight*, Vol. 52, No. 2025, October 16, 1947, pp. 431, 432, illus.

**Progress of a Mammoth British Aircraft; Prototype of Machines for Transatlantic Route; The Bristol Brabazon I Moved to New Assembly Hall.** *Modern Transport*, Vol. 58, No. 1490, October 18, 1947, pp. 3, 7, illus.

**Breguet 761 (4-Engine) Transport.** *Aero Digest*, Vol. 55, No. 3, September, 1947, p. 74, illus.

**North Star (Canadair DC-4M) in Operation.** *The Aeroplane* Vol. 73, No. 1892, September 12, 1947, pp. 371–373, illus. (Cf. AER 10/47:35.)

**The Canadair Four (DC-4M Transport).** *Aero Digest*, Vol. 55, No. 3, September, 1947, p. 74, illus.

**The Development of the Navy-Douglas Model D-558 Research Project.** E. H. Heinemann. *Aeronautical Engineering Review*, Vol. 6, No. 12, December, 1947, pp. 14–19, illus.

Douglas Aircraft Company, Inc., was commissioned to undertake a program of large-scale flight-test research in order to obtain the aerodynamic data required for the efficient and safe design of high-speed aircraft to fly at speeds approaching the speed of sound. Two aircraft, the Skystreak and the Skyrocket, were built. Each was designed to obtain maximum speed with available power plants. Both were equipped with turbojet engines, but the Skyrocket was provided with additional rocket motors to be used for high-speed test purposes. Each airplane carried automatic recording instruments designed to give a complete and continuous record of the aerodynamic characteristics of its high-speed flight. Although the Skystreak is designed for speeds in excess of the speed of sound, the flight-test program calls for its employment only in the transonic range.

**Douglas Unveils Its New Research Plane; (D-558-2) Skyrocket Designed for Sonic Speeds Combines Turbojet and Rocket Power; Features Sweptback Wings.** Robert McLarren. *Aviation Week*, Vol. 47, No. 20, November 17, 1947, pp. 12, 13, illus.

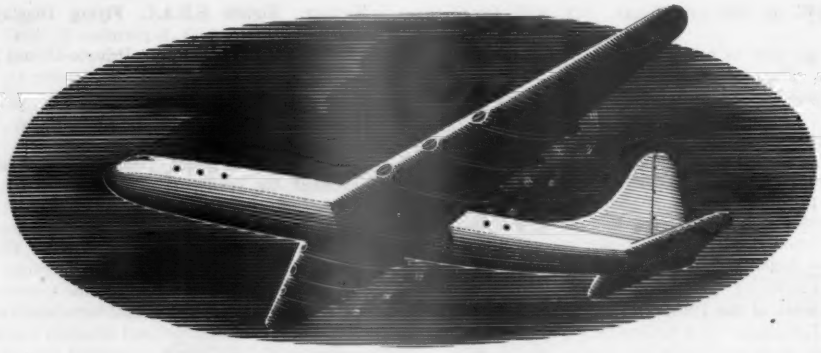
**Douglas DC-6; An Airline Aircraft.** E. F. Burton. *Shell Aviation News* (London), No. 111, September, 1947, pp. 11–14, cutaway diagrs. Details of fire prevention, thermal anti-icing, passenger accommodations, performance, and heating and pressurizing systems.

**Interim Transports; Yorks and Haltons Give Good Passenger and Freight Carrying Service.** *Flight*, Vol. 52, No. 2023, October 2, 1947, pp. 385–388, illus.

**Handley Page Hastings; Britain's Largest and Fastest Military Transport; New Standards of Comfort and Safety.** *Flight*, Vol. 52, No. 2022, September 25, 1947, pp. 359–363, cutaway drawing.

**Hughes Answers Senate Probe with First Flying Boat Flight; 200 Ton, Eight Engine Aircraft Answers Many Questions in Initial Test Hop Over Los Angeles Harbor.** Scholer Bangs. *Aviation Week*, Vol. 47, No. 19, November 10, 1947, pp. 11, 12, illus.

**Development of the Lockheed P-80A Jet Fighter Airplane.** Clarence L. Johnson. *Journal of the Aeronautical Sciences*, Vol. 14, No. 12, December, 1947, pp. 659–679, illus. (Cf. AER 3/47:36.)



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# *HEAT TRANSFER EQUIPMENT*

***to all U. S. manufacturers of large aircraft***

• Before, during and since the war, AiResearch has pioneered the design and manufacture of heat transfer equipment for aircraft. It is the only organization equipped to build entire oil temperature regulating systems for airframe manufacturers.

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AiResearch oil temperature regulators, as well as intercoolers, are famed for their sound, rugged construction. *There has never been a reported failure of AiResearch mechanical joint construction in service.*

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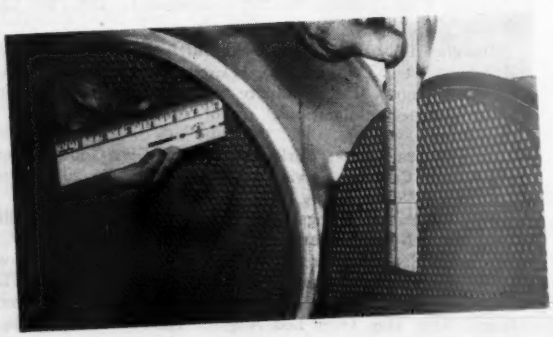

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**Luscombe (Silvaire) Sedan Stresses Comfort; Although Resembling Its Two-Place Forerunner, It Is Larger and Heavier.** Albert E. Smyser, Jr. *Aviation Week*, Vol. 47, No. 20, November 17, 1947, pp. 25, 26, illus.

**Martin 2-0-2 Wing Design Provides Greater Safety, Higher Efficiency.** *The Martin Star*, Vol. 6, No. 8, September, 1947, pp. 8–9, diagrs.

The low drag of the airfoil designed by The Glenn L. Martin Company is obtained by locating the maximum wing thickness at 40 per cent chord. The Martin-developed aileron attains greater lift and is smaller than conventional ailerons, thus permitting longer wing flaps. The double-slotted flaps provide higher lift increases for a given flap setting and make it possible to deflect the higher flap at higher angles. These features permit heavier wing loadings, add to the rate of climb, and enable quicker take-offs.

**Northrop Wing.** *Fortune*, Vol. 36, No. 4, October, 1947, pp. 112–115, 182, illus. A popular account of the development of the Northrop all-wing aircraft.

**Percival Merganser (Twin-Engine Six-Place Transport).** *Aeronautics*, Vol. 17, No. 3, October, 1947, pp. 32, 33, illus. (Cf. AER 9/47:41.)

**Prestwick Pioneer; Appraisal of Scottish Light Communications Aircraft for Specialized Duty.** *Flight*, Vol. 52, No. 2023, pp. 389–392, illus., cutaway diagrs. (Cf. AER 9/47:41.)

**Design Analysis; F-12 Based on Fighter Experience; Republic's Photo Plane, Outgrowth of Same Competition that Bore XF-11, Has Exceptional High Speed and Long Range Characteristics.** Robert McLarren. *Aviation Week*, Vol. 47, No. 19, November, 1947, pp. 28–30, illus.

**Stinson Refines Voyager for 1948.** *Aviation Week*, Vol. 47, No. 19, November 10, 1947, pp. 24, 25, illus.

**The Vickers Valetta; Five Aeroplanes in One.** *The Aeroplane*, Vol. 73, No. 1897, October 17, 1947, pp. 526, 527, illus.

The Vickers Type 607 Valetta C Mk.I is a cargo aircraft based on the Vickers-Armstrong Viking IB. A wide cargo door accommodates the stowage of large pieces of military equipment. Removable appointments adapt the craft to quick conversion from a paratroop transport to a freighter, ambulance, troop carrier, or glider tug.

**The All-Metal Wheelair Plane.** K. S. Coward. *Modern Metals*, Vol. 3, No. 8, September, 1947, pp. 28–32, illus. (Cf. AER 8/47:37.)

## Airplane Operation

**Control of Airplanes on the Ground.** John E. Coats. *Air Facts*, Vol. 10, No. 10, October 1, 1947, pp. 31–46, diagrs.

An analysis of the forces that act on an airplane in a cross-wind landing. A landing technique is outlined in which, during a cross-wind landing and take-off roll, the pilot arcs the airplane downwind sufficiently to produce a centrifugal force equal and opposite to the force of the side wind.

**Built-in Skyhook.** Jeff Lyon. *Skyways*, Vol. 6, No. 12, December, 1947, pp. 22, 23, 44, illus.

A method of extending the rated range of an airplane. By flying an airplane at high altitude and operating the engines at a lower power, a lower fuel consumption is realized. The ground speed is the same as that obtained at a lower altitude using more power. Maximum range will be obtained at an indicated air speed about 50 per cent higher than the flaps-up stalling speed. The method was tested successfully by Dr. L. M. Greene with a Fairchild 24.

## Airports & Airways

**Air Traffic Problem.** Milton W. Arnold. *American Helicopter*, Vol. 8, No. 11, October, 1947, pp. 15, 16, 25, 26. A summary of the aerial highway network plan proposed by the Air Transport Association of America. It includes regulations for helicopter traffic.

**Handling of Lightplane Traffic.** Herbert Zimmer. *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 81, 120, 121, illus.

**Fog Dispersion Experiments at Lockheed Terminal, Burbank, Cal.** *American Meteorological Society, Bulletin*, Vol. 28, No. 7, September, 1947, p. 334.

"NOFOG," a patented fog-dispersal system using burners with a vaporization point of 3,000°F., sprays dry calcium chloride particles into the atmosphere. Four burners are required to clear one runway. The operation takes 15 min. and costs $5.00 per min.

**New Airplane Catapult.** *Electrical Engineering*, Vol. 66, No. 10, October, 1947, p. 979, illus.

The "Electropult," manufactured by the Westinghouse Electric Corporation, is a straight-line induction motor for launching airplanes. The secondary winding of the motor is the track of the catapult, and the primary winding is part of the car to which the airplane is harnessed.

## Atomic Energy

**List of British Declassified Reports on Atomic Energy.** British Information Services, New York, Sales Section, September 22, 1947. 6 pp.

A priced list of 98 reports (B.D.D.A. Nos. 1–98) published from March, 1939, to March 1947, dealing with nuclear fission, chain reactions, radioactive materials, and related topics. Includes twelve reports on fluid flow.

**The Possibilities of Nuclear Energy for Heat and Power Production.** J. B. Cockcroft. (Third James Clayton Lecture.) *Institution of Mechanical Engineers, Proceedings*, Vol. 156, No. 2, 1947, pp. 206–211, illus. Some technical details and simple mathematical theory.

## Aviation Medicine

**Concerning Human Tolerance of Acceleration as It Applies to Certain Jerking Types of Acceleration (Jolt Loads) Which Occur In Flying.** Siegfried Ruff. (*Deutsche Akademie der Luftfahrtforschung, Schriften Nr. 47*, 1942.) *National Research Council, Crash Injury Research*, New York, 1947. 9 pp.

The effect of a sudden acceleration on a man depends partly on its direction, but chiefly on the duration and the manner of distribution in the body. If the forces of inertia are carried through the abdominal belt, properly applied, the body tolerates up to 1700 kg., which corresponds to 26*g*, without injury. The impact of 2,000 kg. of a parachute opening can be absorbed through the leg straps of the harness without great danger to the organism. Experiments showed that 20*g* is the limit of endurance, if the forces are transmitted from the seat to the trunk, as occurs when a catapult seat is used. The action of wind up to 500 km. per hour can be withstood by the exposed face without tissue destruction.

**Investigation Concerning the Influence of Oxygen Inhalation on Alveolar $CO_2$ Tension, Under Low-Pressure Conditions.** Gustav Sigurd Schwopper. (*Luftfahrtmedizin*, Vol. 7, No. 2–3, November 25, 1942, pp. 150–158.) *U.S., Army Air Forces, Library (Washington), Translation No. 408*, December 21, 1945. 18 pp., tables. 10 references.

The protracted inspiration of pure oxygen resulted in a reduction of the alveolar $CO_2$ tension which was in addition to that noted at the end of the ascent to an altitude of 7,500 m. This reduction was not sufficiently great to be characterized as pronounced hypocapnia. No decrease in time reserve was observed which could be attributed to the use of pure oxygen.

**Current Problems of Aviation Medicine.** S. Ruff. (*Luftfahrt und Schule*, Vol. 8, Nos. 7–9, April–June, 1943.) *U.S., Army Air Forces, Library, (Washington), Translation No. 9*, April 11, 1946. 25 pp.

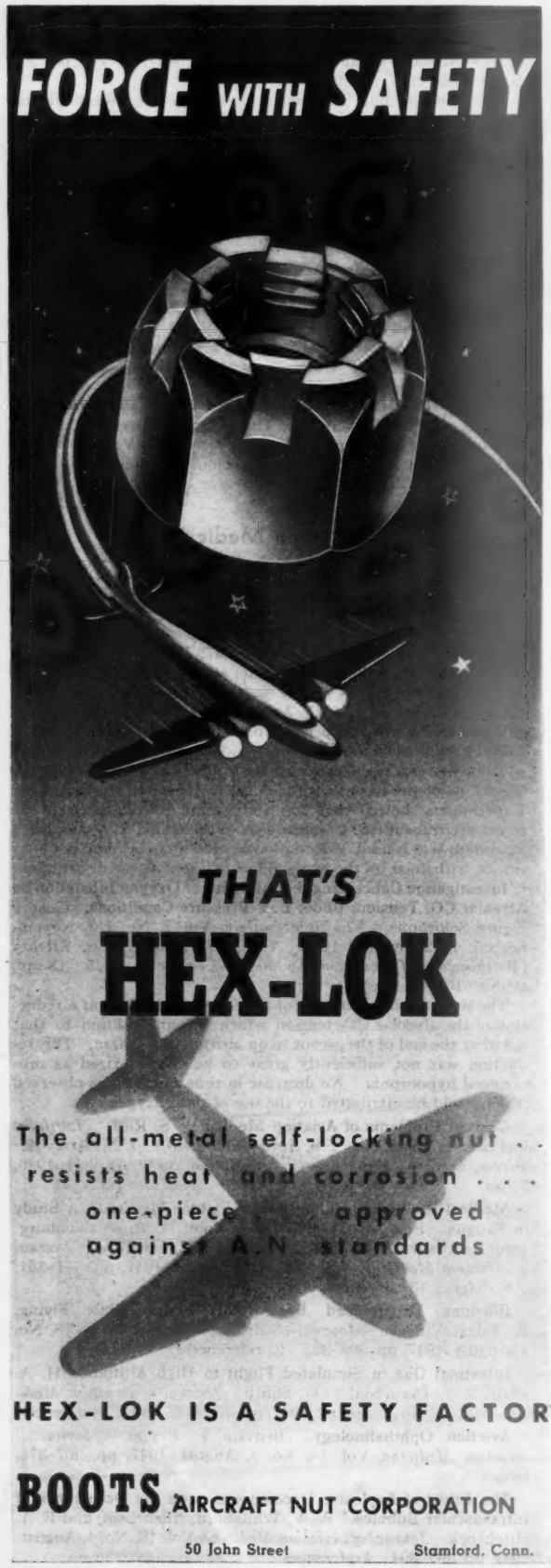
**Medical Problems of Long Range Fighter Missions; A Study in Fatigue.** Emerson M. F. Weaver, John D. Van Valkenburg, John B. Stewart, A. D. McKinley, Jr., and Carl Ermshar. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 341–351, 398, diagrs. 13 references.

**Illusions Experienced by Aircraft Pilots While Flying.** W. Edgar Vinacke. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 308–325. 21 references.

**Intestinal Gas in Simulated Flight to High Altitude.** H. A. Blair, R. J. Dern, and V. G. Smith. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 352–366, illus. 5 references.

**Aviation Ophthalmology.** Brittain F. Payne. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 367–378, tables.

**The Effect of Explosive Decompression on the Occurrence of Intravascular Bubbles.** W. V. Whitehorn, Allen Lein, and F. A. Hitchcock. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 392–394. 4 references.




**Subacute Mercury Poisoning as a Potential Hazard in Nitrogen Dilution Chambers.** B. M. Smith and K. B. Clark. *Journal of Aviation Medicine*, Vol. 18, No. 4, pp. 390, 391.

**Medical Considerations in the Certification of Civil Airmen.** Paul R. Huber. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 384–389.

**Responsibilities of the Practitioner in Civil Aviation in South Africa.** Richard W. S. Cheetham. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 326–340.

**Aviation Medicine in the Navy.** J. C. Adams. *Journal of Aviation Medicine*, Vol. 18, No. 4, August, 1947, pp. 379–383.

## Electronics

**Simultaneous Radio Range and Radiotelephone Equipment.** George T. Royden. *Electrical Communication*, Vol. 24, No. 3, September, 1947, pp. 374–381, illus.

An explanation of the theory and operation of the equisignal system employing two crossed loop antennas, and a detailed description of the transmitter, coupling unit, monitor, and remote-control unit. Radio-range signals provide indications of the location of an aircraft with respect to a specified course and from these signals the range station and the sector in which the craft is flying can be identified. Voice modulation may be imposed on the transmission without interfering with the radio-range signals.

**Development of a Straight-Line Glide Path.** J. M. Lee and H. I. Metz. *U.S., Civil Aeronautics Administration, Technical Development Report No. 55*, June, 1947. 34 pp., illus.

Description of the principles and components of the straight-line glide-path instrument landing system developed by the CAA Experimental Station, Indianapolis. The glide angle can be varied from 2° to 5° and provides a 2.72° path. Lack of receiver sensitivity limits the use of the path to altitudes below 4,000 ft. Reflection from local objects makes the path difficult to fly below 100 ft.

**GCA in the Control Tower.** *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 65, 118, 119, illus. The adaption of the Navy-Bendix all-weather precision landing radar system to provide remote indication at the control tower and control of the entire landing operation by two men.

**The Design of Speech Communication Systems.** Leo L. Beranek. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 9, September, 1947, pp. 880–890, diagrs. 15 references.

A method for calculating the ability of a communication system to transmit speech intelligibly in the presence of noise. The total speech arriving at the ear of a listener is determined by adding the orthotelephonic gain of the system to the speech spectrum that would be produced at the eardrum of the listener by speech uttered at a distance of one meter from the ear. The total noise arriving at the ear is determined in terms of its spectrum level from measurements of the noise pickup of the microphone and the acoustic attenuation of the earphone cushions. The area lying between the spectrum level of the peaks of the speech and the spectrum level of the total noise, when plotted on a distorted frequency scale, determines the quantity called articulation index, which can be correlated with articulation scores. The validity of the method is established by comparison of carefully measured articulation scores with calculated articulation indices.

**Principles of Radio Location and Radio Recognition of Airplanes.** B. Malinovskii. (*Vestnik Vozdushnogo Flota* (Moscow), Vol. 28, No. 13–14, July, 1945, pp. 327, 328.) *U.S., Army Air Forces, Library* (*Washington*), *Translation No. 27-C*, May 16, 1946. 9 pp. An elementary explanation of the principles and an outline of the development of radar location and recognition systems.

**Radio Detectors and Their Use.** F. I. Gorodilov. (*Artilleriiskii Zhurnal* (Moscow), No. 9, 1945, pp. 42–47) *U.S., Army Air Forces, Library* (*Washington*), *Translation No. 29*, May 17, 1946. 14 pp.

A review of the phenomenon of the reflection of ultrashort radio waves, as first employed in antiaircraft detection systems and extended to long-distance indication of approaching aircraft, target pinpointing, precision target-seeking, artillery fuses, and to aircraft and naval navigation aids.

**Discussion on "The Maximum Range of a Radar Set."** Kenneth A. Norton and Arthur C. Omberg. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 9, September, 1947, pp. 927–931, figs. 3 references.

**SCR-545-A—A Completely Automatic Tracking Radar.** C. R. Taft. *Bell Laboratories Record*, Vol. 25, No. 10, October, 1947, pp. 378–382, illus.

**Time Modulation.** Britton Chance. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 10, October, 1947, pp. 1039–1044, diagrs. 5 references.

A brief review of the basic processes employed in time modulation, and representative examples of practical circuits, in accordance with recent developments for radar range-finding, pulse communication, and data transmission.

**Time Demodulation.** Britton Chance. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 10, October, 1947, pp. 1045–1049, diagrs. 4 references.

The demodulation of the signals imparted to carriers by the process of time demodulation is an essential process of radar range-finding, pulse data transmission, and communication. Methods are described for precision demodulation which depend upon a time modulator operating in synchronism with the input information, a time-discrimination element, and negative feed-back connections that control the local time modulator to reproduce the modulating signal in an electrical or mechanical form. Accuracies are usually set by the bandwidth of the radio link and may be 5 parts in $10^4$ or better.

**A Microwave Frequency Standard.** Richard G. Tapley and Harold Goldberg. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 9, September, 1947, *Waves and Electrons Section*, pp. 965–969, diagrs. 2 references.

Following a theoretical discussion, a frequency standard is described which employs a silicon point-contact rectifier as a nonlinear element to generate frequencies up to at least 10,000 mc. Harmonics are identified by a coaxial-line-type wavemeter and detected by a superheterodyne detector. Characteristics in the microwave region have been satisfactory, and the standard is as simple to use as the conventional standards employed for frequencies below 50 mc.

**Cathode-Ray Presentation of Three-Dimensional Data.** Otto H. Schmitt. *Journal of Applied Physics*, Vol. 18, No. 9, September, 1947, pp. 819–829, diagrs. (Cf. AER 8/47:53.).

Simple electrical transformations can be applied to the cathode-ray oscilloscope, which ordinarily displays data in one or two variables as a function of time. A presentation can be obtained of three variable electrical data in the form of isometric or other conventional projections, or as true perspective drawings. The observer's point of view in the presentation coordinate system can be varied by adjustment of the elevation and azimuth controls. Separate pictures can be presented to each eye by a more elaborate but similar set of transformations. These pictures, which can be superimposed by optical means, can be made to differ so that the picture obtained will have stereoptically correct perspective.

**Southwest Airways Testing 58-Pound Picture Radar.** Fred Hunter. *American Aviation*, Vol. 11, No. 11, November 1, 1947, p. 26, illus.

The airborne radar equipment now under test by Allison Radar and Equipment Company is similar to the APS-10 but develops 40 kw., instead of 8 kw. It may be set for ranges of 15, 50, or 150 miles. The center point of the radar scope has been lowered to near the bottom rim of the 5-in. screen, thereby doubling the size of the image without increasing the size of the scope. The image is sharper and clearer than that of the APS-10.

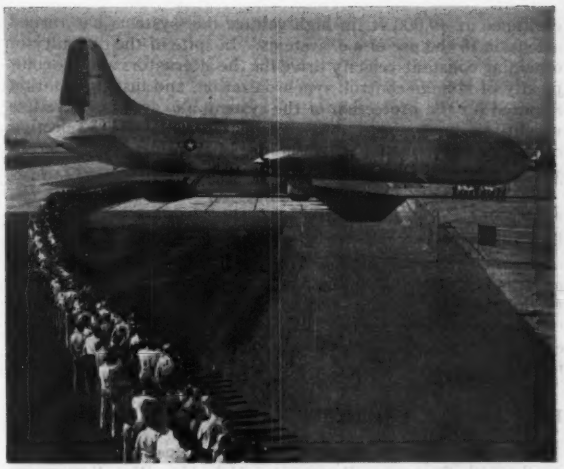
**Broad-Band Noncontacting Short Circuits for Coaxial Lines. I—TEM-Mode Characteristics. II—Parasitic Resonances in the Unslotted S-Type Plunger.** W. H. Huggins. *Institute of Radio Engineers, Proceedings*, Vol. 35, Nos. 9, 10, September, October, 1947, pp. 906–913; 1085–1091, diagrs. 2, 4 references.

**Choice of Waves for Stable Communication.** N. Bulatov. (*Sviaz' Krasnoi Armii* (Moscow), 1943, pp. 45–48.) *U.S., Army Air Forces, Library* (*Washington*), *Translation No. 38*, May 31, 1946. 11 pp., tables.

**A Note of Coupling Transformers for Loop Antennas.** M. J. Kobilisky. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 9, September, 1947, *Waves and Electrons Section*, pp. 969–973, diagrs. 3 references.

**Discussion on "The Transverse Electric Modes in Coaxial Cavities."** Robert A. Kirkman and Morris Kline. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 9, September, 1947, pp. 931–935, figs. 2 references.

**A Wide-Band Transformer from an Unbalanced to a Balanced Line.** Eugene G. Fubini and Peter J. Sutro. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 10, October, 1947, *Waves and Electrons Section*, pp. 1153–1155, diagrs. 1 reference.



**Simulating troops, 400 employees of Consolidated Vultee Aircraft Corporation line up two abreast to demonstrate the passenger-carrying ability of the world's largest military landplane, the XC-99.**

**Some Designs and Applications for Packaged Amplifiers Using Subminature Tubes.** Britton Chance, J. N. Thurston, and P. L. Richman. *Review of Scientific Instruments*, Vol. 18, No. 9, September, 1947, pp. 610–616, illus. 8 references.

**German Scientific Library of the BHF.** John R. Spicklemire. *U.S., Air Force, Report No. BHF-753*, September, 1947. 152 pp. (Reprint of *F.I.A.T. Final Report No. 753.*)

A detailed index of the library of the German High-Frequency Research Authority. The Authority was set up in April, 1943, and the library was in operation until May, 1945. The library contains approximately 2,400 classified-research reports, progress sheets, periodicals and items of correspondence on high-frequency technique, communications, radar, and related fields. Individual abstract reports were prepared for each document and were issued in the TL/UK series numbered from 1 to 2366. The classification divides the documents into 21 main sections identified by a Roman numeral and a letter. These sections are divided into subsections designated by an index digit followed by a serial number. In this index the items are listed by document number, followed by the English title and the microfilm reel number.

**The Electronic Research Sponsored by the Office of Naval Research.** E. R. Piore. *Institute of Radio Engineers, Proceedings*, Vol. 35, No. 10, October, 1947, *Waves and Electrons Section*, pp. 1119–1121. 18 references.

## Equipment

**Accessory Exhibits at Radlett; Full Alphabetical List Giving Précis of Principal Features Being Shown on the Accessory Manufacturers' Stands.** *Flight*, Vol. 52, No. 2020, September 11, 1947, pp. 299–304, illus.

Short synopses of the exhibits of 155 manufacturers of parts and accessories for air frames, engines, and propellers, and auxiliary equipment. The listing runs alphabetically by company name, with address.

**Air Ducts of Nonmetallic Materials, Types and Applications.** Watson G. Harding. *Product Engineering*, Vol. 18, No. 10, October, 1947, pp. 138–140, illus. Nonmetallic ducts offer advantages in noise reduction, vibration-fatigue resistance, and light weight. Typical constructions and characteristics are tabulated.

### ELECTRICAL

**A-C Systems for Large Aircraft.** J. D. Miner. *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 40–42, illus.

An outline of the development of a.c. power supplies for aircraft. The technical difficulties of current interruption and fault

clearance at 40,000 ft. in high-voltage d.c. systems has turned attention to the use of a.c. systems. In spite of the difficulty of obtaining constant velocity drive for the alternators and the complexity of voltage control, synchronization, and instrumentation required for the protection of the system, a.c. systems have less weight, a.c. motors are more dependable, and voltage selection can be done more simply by the use of transformers. The advantages are emphasized in high-altitude aircraft.

**Cannon Plugs; Type DP Connectors.** *Cannon Electric Development Co., Bulletin No. DP-547, 4th Ed.*, May, 1947. 23 pp., illus., diagrs.

A catalog of multiple connectors for use with rack or panel electrical or electronic equipment. Correct polarity of the contacting elements is ensured by the taper on the engaging portions or by pin and socket guides. A special direct and remote mechanical disconnecting mechanism is incorporated in models intended for use with aircraft instrument-board assemblies.

### HYDRAULIC & PNEUMATIC

**High-Pressure Gear Pumps.** T. E. Beacham. *Institution of Mechanical Engineers, Proceedings*, Vol. 155, War Emergency Issue No. 24, 1946, pp. 417–429, Discussion, pp. 429–438, Communications, pp. 439–452, diagrs.

The principal problems presented by high-pressure gear pumps are the load on the journal bearings, wear of the gear, and the reduction in volumetric efficiency caused by internal leakage. The number of teeth and the width-diameter ratio of the gears are controlling factors in the journal load. At high pressures it is difficult to accommodate standard ball bearings and roller races because of their diameter. Designs are illustrated which use a combination of standard races and special needle roller bearings. Wear in most cases is caused by attrition of the gear end faces by solid matter in the liquid being pumped. This difficulty can be eliminated by filtration of the liquid or reduced by absorbing the driving torque with two pinion gears coaxial with the pump gears. At low speeds and with low-viscosity liquids, internal leakage can limit the pressure at which the pump can be used. Multistage pumps reduce the leakage and have been used extensively. A graph shows the relationship between the limit pressure at which 80 per cent efficiency is possible and the capacity of the pump, its speed of rotation, and the viscosity of the liquid. Aircraft pumps generally employ gears with involute teeth and incorporate ports in the end covers of the casing to prevent excessive pressure in the liquid trapped between the teeth.

**Liquid Springing.** A. E. Bingham. *Engineering*, Vol. 164, No. 4261, September 26, 1947, pp. 289–291, illus. (Cf. AER 4/47:31.)

## Flight Testing

**Instrumentation.** S. C. Caliendi. *De Havilland Gazette*, No. 40, August, 1947, pp. 10, 11, illus.

A description of the instruments and measuring techniques developed by the instrument laboratory of the de Havilland Aircraft Company, Ltd., for the instrumentation of flight tests.

## Fuels & Lubricants

**Solid and Liquid Propellants.** W. H. Wheeler, H. Whittaker, and H. H. M. Pike. *Paper presented before the Institute of Fuel*, London, February 5, 1947. 16 pp., figs.

A general survey of the nature, manufacture, properties, and combustion characteristics of solid and liquid fuels, and of mono- and bi-fuel propellant systems. The properties of the gaseous products of combustion of various fuels provide the basic data from which the thrust of a given nozzle can be calculated. Formulas are developed for the performance index and the fuel-weight ratio of a propellant system. These factors determine the design of combustion chambers and fuel delivery systems. A comparison of solid-fuel and pressure-expulsion systems indicates that, theoretically, the use of solid propellants should afford a reduction in overall weight for units of equal efficiency.

**Orifice Discharge Coefficients in the Viscous-Flow Range.** G. S. Peterson. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 7, October, 1947, pp. 765–768, illus. 5 references.

Data on the use of a thin-plate orifice for the measurement of the flow of viscous fluids. Calibration curves and orifice coefficient curves are given for two units used to measure lubricating-oil flow rates in an aircraft engine during flight.

## Gliders & Gliding

**Gliders and Sailplanes; New Models at Radlett.** *Flight*, Vol. 52, No. 2020, September 11, 1947, pp. 290, 291, illus.

## Guided Missiles

**Operation Neptune; Qualified Success of First Experiments.** *Flight*, Vol. 52, No. 2025, October 16, 1947, pp. 446–448, illus.

A description of the launching of a Vickers transonic rocket-propelled test missile from an R.A.F. Mosquito. The launching was successful and the jets fired correctly, but the missile dived immediately instead of following its preset course. A six-way transmitter provided telemetering of aerodynamic data.

**German Guided and Rocket Missiles. I, II.** Eric Burgess. *The Engineer*, Vol. 184, No. 4784, 4785, October 3, 10, 1947, pp. 308–312; 332, 333, illus.

**I.** Description of the Hs 293, an air-to-sea rocket-propelled missile that was used successfully in World War II. A layout diagram of the missile and its Walter cold-cycle propulsion unit is given. Comparative characteristics of the entire family of rocket missiles developed from this parent unit are tabulated.

**II.** Design and performance characteristics of the Hs 298 and the Hs 117 Schmetterling. The Hs 298 is an air-air radio-controlled rocket missile. The solid fuel charge has a hollow center that contains a fast-burning composition providing a high initial thrust of 330 lbs. The shaped charge keeps the subsequent burning at a rate that yields 110-lbs. thrust. The Schmetterling is a ground-air radio-controlled rocket missile. The main power plant uses liquid fuel and is fuel-cooled. Either the BMW 109-558 or the Walter 109-729 engine is used. Two booster rockets, which are jettisoned when the charge is exhausted, augment take-off thrust.

**Don't Underestimate the Difficulties of Guided Missiles Problems. I, II.** Lawrence R. Hafstad. *U.S. Air Services*, Vol. 32, Nos. 9, 10, September, October, 1947, pp. 7–10; 25–27, 32, illus.

**The Push-Button War Fable.** William Winter. *Flying*, Vol. 41, No. 4, October, 1947, pp. 47–49, 71, 72, illus.

A summary of current research on guided missiles. A table listing 28 rockets and guided missiles developed in the United States gives Army and Navy designations, manufacturers' names, bomb loads, types of controls, and gross weights.

## Ice Prevention

**Experimental Evidence Supporting the Dependence of the Icing Limit upon the Flying Speed.** W. Findeisen and B. Walliser. (*Germany, Reichswetterdienst, Forschungsund Erfahrungsberichte, Series A, No. 20*, 1943.) *U.S., Army Air Forces, Library (Washington), Translation No. 405*, December, 1945. 20 pp.

The passage of an aircraft through the air produces a heating effect due to compression or friction. At high speeds this effect is of sufficient magnitude to keep the airplane ice-free at air temperatures below the freezing point of water. A formula for this heating effect was verified by measurements taken during test flights and by laboratory data.

**Icing Test on the Intake Duct of the Ju 88 Standard Bomber and Fighter.** Paul Hentrich. (*Göttingen, Aerodynamische Versuchsanstalt, ZWB/AVAG/40/7/15*, November, 1940.) *U.S., Air Force, Translation No. F-TS-2674-RE*, October, 1947. 20 pp., illus.

In addition to dimensional and air-flow characteristics, the thermal conditions at the intake duct were reproduced. Tests were conducted under icing conditions in a wind tunnel.

**Means of Prevention of Ice Formation on Aircraft. II.** D. G. Thorpe. *The Technical Instructor*, Vol. 2, No. 9, September, 1947, pp. 1–6, illus.

The T.K.S. fluid deicing system pumps a fluid to porous-metal distributors situated in the leading edge of the airfoil and to the propeller slinger ring. From the distributor the fluid is carried over the surface of the airfoil by the airflow. The deicing medium, R 328, exerts a depressing effect on the freezing temperature of

water and is sufficiently immiscible to maintain a uniform boundary layer of fluid under the impact of the supercooled water droplets.

**Aircraft De-Icing Systems.** D. O. MacDougall. *Shell Aviation News* (London), No. 11, September, 1947, pp. 15–17, illus. Mechanical, liquid, and thermal systems.

## Installations

### SHIPBORNE

**Naval Aircraft and Carrier Equipment.** L. Boddington. *Royal Aeronautical Society, Journal*, Vol. 51, No. 442, October, 1947, pp. 800–826, illus., Discussion, pp. 826–831. 1 reference. (Cf. AER 9/47:41.)

The catapult, arresting gear, safety barrier, and the jet-assisted take-off installations used in connection with naval aircraft. Towing is the principal method of deck launching now in use; a towing shuttle and a tow line are used on the deck and a hydraulic power system below the decks. The acceleration characteristics of British and American designs of towing gear are considered in relation to the stability of the aircraft during launching. Rocket-assisted take-off devices were developed during World War II to accommodate for the low speeds and restricted deck run on converted merchant-ship escort carriers. Arresting gear consists essentially of a rope system that is picked up by the landing aircraft to apply a deceleration to the aircraft by hydraulic braking. The basic retardation curve of the system and the effect of the initial impact wave of the arrester wire and hook bounce on the behavior of the aircraft are analyzed. The construction and operation of the safety barrier are outlined.

## Instruments

**A Note on the Theory of Corrugated Diaphragms for Pressure-Measuring Instruments.** Alfred Pfeiffer. *Review of Scientific Instruments*, Vol. 18, No. 9, September, 1947, pp. 660–664, diagrs.

A hypothetical model consisting of one flexural and one tension spring acting in parallel is analyzed to obtain a correlation between the pressure acting on the diaphragm and the corresponding deflection, the effective diameter, the sheet thickness, and the plate modulus. The formula obtained for the elasticity when it contains only two terms checks well with experimental test data.

**Luminescence of Enemy Aircraft Instrument Dials.** J. R. De Vore. (U.S., Office of Scientific Research and Development, National Defense Research Committee, War Metallurgy Division.) *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./1483*, August 16, 1944. 12 pp., illus. British Information Services, New York. $0.70.

An evaluation of the luminescence of 14 Japanese and German aircraft instrument dials. The radioactive markings on the Japanese instruments are three to four times as bright as the markings on the German instruments. This difference is caused not by the differences in age of the activated phosphors but rather by an initial difference in intensity of the activation. The investigation was made by the Battelle Memorial Institute for the Research Division of the New Jersey Zinc Company (of Pennsylvania).

**Nomographic Representation of the Elastic Contact Conditions Between Steel Pivot and Sapphire Jewel.** G. F. Tagg. *Journal of Scientific Instruments*, Vol. 24, No. 9, September, 1947, pp. 244–248, diagrs. 4 references.

**The Effect of Variations in Indicator Design Upon Speed and Accuracy of Altitude Readings.** Walter F. Grether. *U.S., Army Air Forces, Air Materiel Command, Aero Medical Laboratory, Memorandum Report No. TSEAA-694-14*, September 2, 1947. 19 pp., diagrs. 3 references.

A pilot-interview study determined that the conventional altimeter is difficult to read and that all sensitive or multirevolution instruments should incorporate a single sensitive pointer supplemented by a Veeder-type counter to indicate the number of completed pointer revolutions above zero. The digits on the counter should be large enough to be legible under night lighting conditions and should not be obscured when the pointer is in its most common position during normal flight.

**Metallurgical Examination of a German and Japanese Aircraft Rate of Climb Indicator.** L. R. Jackson, W. W. Beaver, and H. W. Gillet. (U.S., Office of Scientific Research and Development, National Defense Research Committee.) *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./1471*, September 15, 1944. 19 pp., illus. British Information Services, New York. $0.90. Report of the chemical and physical analyses. Both instruments were manufactured in 1942, the German by Dr. Th. Horn, Leipzig, and the Japanese instrument by Tokyo Koku Keiki.

**The Distance Reading Gyro Magnetic Compass.** A. S. Lucking. *The Technical Instructor*, Vol. 2, No. 9, September, 1947, pp. 7–9.

A remote-reading directional gyro that is continuously corrected by a magnetic compass. The compass magnet exerts its control through two small electromagnets known as pot magnets, energized through contact strips in the magnet system housing. Either pot magnet, when energized, induces eddy currents in a copper dome carried by the gyroscope rotor, and the interaction of these eddy currents with the field from the pot magnets tends to precess the gyroscope's shaft toward the energized pot magnet. Thus the gyroscope shaft is maintained in an east-and-west direction. The gyroscope may have an uncontrolled wander but the compass magnet, which is capable of monitoring at 60° per minute, effectively masks this free wander. A variation setting corrector, which is in effect a repeater motor, permits the indication transmitted by the master to be corrected for local variation before it activates the slave unit.

**Engine Cylinder Thermometer.** C. Williams. *The Technical Instructor*, Vol. 2, No. 9, September, 1947, pp. 10–13, illus.

A moving coil instrument using a copper-constantan thermocouple. The hot junction is in the aircraft engine, and the indicator is the cold junction of the thermocouple. A bimetal spring that acts on the moving coil corrects the reading for variation in temperatures at the cold junction.

**Device for Measuring Torque.** A. Moertsell. (*Teknisk Tidskrift*, Vol. 77, No. 20, May 17, 1947, pp. 437, 438.) *Engineers' Digest*, Vol. 4, No. 9, September, 1947, p. 428, diagrs.

A device to obtain a remote indication of the torque transmitted from one rotating shaft to another. A coupling element between the shafts transmits the torque through springs. The distortion of the springs produces a proportional displacement of the movable part of the measuring element which acts in one leg of a bridge circuit producing electrical indication proportional to the transmitted torque.

**Odometer Would Count Engine RPM's.** Glenn D. Angle. *Airports*, Vol. 12, No. 3, September, 1947, p. 31, illus.

An odometer incorporated as an engine accessory would make it possible to obtain an accurate reading of the number of hours of operation of the engine. If the instrument were factory sealed, it would provide a positive record for determining the maintenance obligation of the engine manufacturer, or a scale to establish the engine trade-in value.

**Automatic Control.** *Flight*, Vol. 52, No. 2024, October 9, 1947, pp. 413–418, illus.

The operational sequence of the transatlantic flight of the Robert E. Lee between Stephenville, Newfoundland, and Brize Norton, England, in September, 1947. The sequence was preset in the Mk.II Automatic Flight Controller. From take-off to final taxi-run, compass readings, radio beacons, and the instrument landing system at the destination guided the controller without intervention of the pilot.

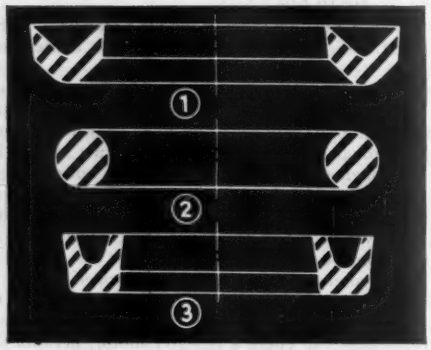
**The Smiths Automatic Pilot (S.E.P. 1).** *The Aeroplane*, Vol. 73, No. 1895, October 3, 1947, pp. 470–473, illus., cutaway diagrs.

The Smith S.E.P. 1 Automatic Pilot is a rate-rate, rather than a displacement-type, instrument. Three interchangeable gyroscopes measure the rate of turn about the vertical and two horizontal axes, respectively. Three separate electric servomotors are harnessed, each through its channel, to the appropriate gyroscope. The gyro signal is fed into the amplifier and backed off by a signal proportional to motor speed from a feed-back generator on the servomotor rotor shaft. This makes the rate of movement of the control surface proportional to the rate of turn of the aircraft about the corresponding axis. The all-electric feature of this system permits the indications of blind flying aids to be fed directly into control circuits.

**S.E.P. 1 in the Air; The First British Electric Automatic Pilot in Operation; Convincing Demonstration of New Technique.** *Flight*, Vol. 52, No. 2023, October 2, 1947, pp. 379.

**A New Autopilot; General Survey of the Smith's Electric Pilot: Entirely New Basis of Control: Maintenance Eliminated.** *Flight*, Vol. 52, No. 2022, September 25, 1947, pp. 364–367, illus.

# Sealed Right?

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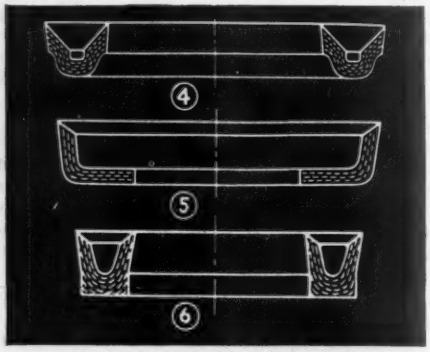


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## Laws & Regulations

**Procedure in New Route Cases Before the Civil Aeronautics Board.** Howard C. Westwood. *Journal of Air Law and Commerce*, Vol. 14, No. 3, Summer, 1947, pp. 267–288.

**Helicopters and the Changes They Require in Aviation Law.** L. Welch Pogue. *Journal of Air Law and Commerce*, Vol. 14, No. 3, Summer, 1947, pp. 300–308. 7 references.

**State Aviation Officials—Some of Their Duties, Responsibilities, and Activities.** Madeline C. Dinu. *Journal of Air Law and Commerce*, Vol. 14, No. 3, Summer, 1947, pp. 309–317. 21 references.

**Frontiers of Aviation Law.** Pat McCarran. *Journal of Air Law and Commerce*, Vol. 14, No. 3, Summer, 1947, pp. 344–350. 9 references.

The development of the aviation industry has reached a point where it is imperative that it be governed by laws made by legislators rather than by regulations imposed by administrative bodies acting in a legislative capacity.

**Enforcement of Air Safety Regulations.** Richard E. Elwell. *Journal of Air Law and Commerce*, Vol. 14, No. 3, Summer, 1947, pp. 318–332. 18 references.

**State Aviation Legislation.** Herzel H. E. Plaine. *Journal of Air Law and Commerce*, Vol. 14, No. 3, Summer, 1947, pp. 333–343. 47 references.

**Airport Legislation and Court Decisions.** Charles S. Rhyne. *Journal of Air Law and Commerce*, Vol. 14, No. 3, Summer, 1947, pp. 289–299. 56 references.

## Machine Elements

**Kinematics of Disk Cam and Flat Follower.** Allan H. Candee. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 7, October, 1947, pp. 709–724, illus. 12 references.

The determination of the proper shape of a cam to produce a required motion by means of "geometrical kinematics." The general principles of geometry and kinematics are applied, and the graphical method is extended beyond the determination of a cam profile as the envelope of the follower. Points of contact and centers of curvature can be determined by kinematic methods. Accurate cam dimensions can be determined by calculations based on the geometrical constructions.

**Application of Tables for Helical Compression and Extension Spring Design.** H. F. Ross. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 7, October, 1947, pp. 725–734, figs. 8 references.

The tables cover all standard steel-wire gages between 0.025 and 0.394 in., music-wire gages between 0.010 and 0.118 in., and most even fractional dimensions. Odd wire sizes or nonferrous materials can also be derived. Design considerations and limitations are summarized with examples of application of the tables.

**Coefficient of Friction, Oil Flow and Heat Balance of a Full-Journal Bearing.** P. I. Orloff. (*Tekhnika Vozdushnogo Flota* (Moscow), Vol. 9, January, 1935, pp. 25–56.) *U.S., N.A.C.A., Technical Memorandum No. 1165*, October, 1947. 56 pp., diagrs. 19 references.

The coefficient of friction of a bearing depends primarily on the viscosity of the lubricant rather than on the load on the bearing surface. Analysis of the flow of the lubricant and the heat balance in the bearing shows that the load-bearing capacity is determined principally by the bearing temperature if no provision is made for increasing the circulation of the lubricant in the bearing. If, however, forced circulation is used, the load-bearing capacity is determined mainly by the temperature of the inlet oil.

**Safety Devices for Nuts and Bolts.** Hans Schaefer. (*BMW Flugmotorenbau G.m.b.H., BMW/EZ V/418–44*, April, 1944.) *U.S., Army Air Forces, Translation No. F-TS-2735-RE*, September, 1947. 32 pp., diagrs. A summary of the design features of the most important types of devices used for locking nuts and bolts, and their application to the BMW-801 D and BMW-801 E engines.

**The Frequency-Response Method of Control Analysis.** William C. Moog. *Instruments*, Vol. 20, No. 9, September, 1947, pp. 811–816, diagrs. 9 references.

The components of the typical control-system equation are resolved in the form of frequency-response diagrams. The curves are combined to form the system curve and are used to read the system stability, response, and steady-state error. The same curves are developed mathematically in terms of the physical con-

stants of the system. The effects of integral and derivative components are illustrated by modifications to the typical system.

## Maintenance

**When Vulnerable Be Vigilant.** Ralph S. Johnson. *Air Transport*, Vol. 5, No. 10, October, 1947, pp. 40, 41.

New airplanes with pressurized cabins, more complicated and higher-voltage electrical systems, electrically-driven gyroscopic instruments, and reversible propellers may require revision of established maintenance schedules. Long-range economy requires careful maintenance vigilance, thorough reporting by the crews and pilots, and systematic follow-up and inspection by ground crews.

**Douglas Service,** Vol. 5, No. 11, November, 1947. 20 pp., illus., diagrs.

Contents: Generator Controls—Description of DC-6 Eclipse System. Heater Overheat Switches, DC-4. Landing Lights, DC-6—Template for Adjustment of Light Position. Long Beach Factory—Service, Maintenance, and Overhaul Center. Self-Locking Nuts, Reclaiming Used Stop Nuts. Rivet Determination, DC-4, DC-6—Integral Wing Fuel Tank Boundary Repairs. DC-6 Supercharger Improvement—Changes on High- and Low-Speed Superchargers. Sealed Structures Riveting, DC-6—Douglas Trim-Flush and NACA Methods. Advance Engineering Changes, DC-6. Service Bulletins, DC-4. Water System, DC-6—Description, Servicing, and Winterization. Propeller Anti-Icing Relay, DC-6. Cabin Pressure Control Desiccator, DC-6—Correct Installation.

## Materials

**Directory of Materials; 14th Ed.** *Machine Design*, Vol. 19, No. 10, October, 1947, pp. 179–246. Machine Design, Cleveland. $1.00.

The first list of the directory is arranged alphabetically by the trade name of the material and includes brief descriptions of composition, properties, characteristics, and applications. A second list, by type, can be used to find and compare similar materials and to select an alloy on the basis of its composition. The third part is an alphabetical list of the producers giving their complete addresses and the type of materials produced and their trade names. Stainless steels are listed separately by standard AISI grades and are followed by a list of the trade names under which they are marketed, and their producers. The directory includes many new alloys, plastics, ceramics, and nonmetallics.

**Supersonic Examination of Materials; Outstanding Characteristics of Supersonic Waves above 20,000 Cycles and Their Use for Detecting and Locating Flaws in Metals, Plastics, and Other Materials Used in Design.** Benson Carlin. *Product Engineering*, Vol. 18, No. 10, October, 1947, pp. 113–118, illus.

### METALS & ALLOYS

**Heat-Resistant Alloys for Use in Jet Propulsion Engines.** J. W. Freeman, E. E. Reynolds, and A. E. White. *Journal of the Aeronautical Sciences*, Vol. 14, No. 12, December, 1947, pp. 693–702, tables. 9 references. (Cf. AER 5/47:27.)

**High Temperature Disc Forging Developments for Aircraft Gas Turbines.** L. B. Fonda. *Steel Processing*, Vol. 33, No. 9, September, 1947, pp. 564–567, illus. (Cf. AER 12/47:51.)

If a rotating machine element has good ductility, the minor defects in the wheel will not materially affect the bursting speed of the wheel. The highest overall ductility in the plane of maximum stress can be obtained by control of grain flow within the forging by proper solution treatment.

**General and Stress Corrosion of Spot-Welded Magnesium Alloy Sheet.** W. F. Hess, T. B. Cameron, D. J. Ashcraft, and R. A. Wyant. *The Welding Journal*, Vol. 27, No. 9, September, 1947, pp. 539-s–544-s, illus. 13 references.

There is no evidence that unstressed spot welds in magnesium-alloy sheet become foci for selective corrosive attack unless the weld has been contaminated by the transfer of copper from the electrodes during welding. When exposed to a corrosive medium, spot-welded magnesium-aluminum-zinc-alloy sheet (Mg-6Al-1Zn and Mg-3Al-1Zn) in hard-rolled temper was found to be subject to stress-corrosion cracking that originated in the heat-affected zone around the fused nugget of the weld. A rather sharply defined limiting stress was noted at which failure occurred within a reasonable time. Below this stress the life of the weld was indefinite. The recommended heat-treatments, whether applied before or after the welding, did not improve corrosion resistance. Stressing welds under loads of less than their shear strength for considerable periods before introduction of the corrosive medium improved the resistance to stress-corrosion cracking. Prestressing raised the stress-corrosion cracking limit to a value safely above that at which spot welds would normally be stressed in service. This prestressing does not change the shear strength of the weld appreciably.

**Aluminum Alloys for Gas Welding with Special Reference to Aluminum-Silicon-Copper Alloys.** J. Pendleton and E. A. G. Liddiard. *Sheet Metal Industries*, Vol. 24, No. 246, October, 1947, pp. 2062–2066, 2068, tables.

Aluminum alloys containing 2.5–5 per cent copper and 5–10 per cent silicon, when welded in the solution-treated condition, gave welded strengths of 16–23 tons per sq. in. In the absence of magnesium and with a copper content of 2.5 per cent, alloys with either 5 or 10 per cent silicon showed no appreciable heat-affected zone in the basis metal near the weld. This is the result of the relatively sluggish response of these alloys to precipitation treatment. The presence of magnesium, however, makes the alloys age-hardening and causes a heat-affected zone to appear in the metal adjacent to the weld.

**The Corrosion of Metals. VIII—Aluminum and Its Alloys.** *Sheet Metal Industries*, Vol. 24, No. 246, October, 1947, pp. 2026–2028, figs. 6 references.

Susceptibility to corrosion bears a direct relation to the solution potentials of the alloy components. The development of intercrystalline corrosion is determined in part by the stresses to which the specimen is subjected. In practice these stresses are usually residual or internal stresses caused by cold-working or forming. Stress corrosion is also influenced by the composition and the method of heat-treatment of the alloy.

**Electro-Thermic Production of Aluminum-Silicon Alloys at Lurgi-Thermie G.m.b.H., Horrem.** H. R. Williams. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 967.* 8 pp., diagr. British Information Services, New York. $0.35.

**The Apparent Yield Strength of Plain Carbon Steel.** J. A. Pope. *Engineering*, Vol. 164, No. 4260, September 19, 1947, pp. 284–288, diagrs. 7 references.

In all strength tests in which the distribution of stress is nonuniform, two variables are present, the size of the specimen and the stress-distribution pattern. In other experiments the criterion of failure is assumed, and, from the test results, laws are deduced for the effect of the distribution of stress and the size of the specimen. If the upper yield strength is to be used as a basis for the design of structures with a diameter greater than 1 in., the diameter of those specimens that are tested in pure tension should be not less than 1 in. If the structure is greater than 0.5 in. in diameter, specimens for pure bending tests should have a diameter not less than 0.5 in. However, billets that are to be tested in combined direct stress and torsion and in bending for a structure greater than 1-in. diameter should themselves be not less than 1 in. in diameter.

**High Expansion Steel Control Cable.** Edward Dugger and H. W. Sedam. *U.S., Army Air Forces, Technical Report No. 5563*, March 24, 1947. 29 pp., figs.

Laboratory-test report on the mechanical and physical properties of "Equi-tract," a special steel-alloy tinned preformed control cable manufactured by the American Steel and Wire Company. Strength characteristics approximate those of corrosion-resistant steel and carbon-steel cable; the coefficient of expansion approaches that of aluminum alloy.

**Testing the Super Alloys.** T. Y. Wilson. *Steel Horizons*, Vol. 9, No. 4, pp. 14–16, illus.

Brief data on the properties of three alloys for service in the temperature range of 1,000–1,500° F., Allegheny Ludlum S-588, S-590, and S-816. Testing equipment and procedures are described.

**The 1350° F Stress-Rupture Properties of Two Wrought Alloys and Three Cast Alloys.** E. E. Reynolds, J. W. Freeman, and A. E. White. *U.S., N.A.C.A., Technical Note No. 1380*, November, 1947. 23 pp., illus. 5 references.

Rupture-test characteristics at 1,350° F. of two wrought alloys in the solution-treated and aged condition, NR-82 (6059 modified-low carbon), and NR-84 (N-155 modified-low carbon), and three precision-cast alloys in aged condition, NR-71 (X-40), NR-87

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(Co-Cr-Ni base-9Mo) and NR-90 (Co-Cr-Ni base-5Mo, 5W). A correlation of N.A.C.A. and O.S.R.D. data shows the variation of rupture strengths with temperature for the alloys between 1,350° and 2,000° F.

**An Indentation Method for Measuring Wear.** Samuel A. McKee. *U.S., National Bureau of Standards, Journal of Research*, Vol. 39, No. 2, August, 1947, pp. 155–161, illus. (Cf. AER 12/47/:41.)

**Babbitt Alloys for Plain Bearings. II.** F. G. Forrester. *Engineering*, Vol. 164, No. 4258, September 5, 1947, pp. 234, 235, diagrs.

Static, centrifugal, and pressure die casting are used in the production of Babbitt bearings. In any method, contamination of the Babbitt metal by the backing material must be prevented. Solidification of the Babbitt must proceed from the surface of the tinned backing to the bearing face, which will localize any contraction cavities on the working surface of the bearing, where they may be eliminated by machining.

**Influence of Structure and Composition on the Elastic Properties of Metallic Alloys.** L. Guillet. (*Le Génie Civil*, Vol. 124, No. 3, February 1, 1947, pp. 45–50.) *Engineers' Digest*, Vol. 4, No. 9, September, 1947, pp. 429–432, diagrs.

The elastic modulus is an atomic property of metals and alloys and is only slightly affected by chemical composition or structure. If an alloy is to retain its metallic character, in particular its malleability, it is not possible to modify appreciably the modulus of a metal by alloying. Only an intermediate modulus value between those of the constituent metals can be obtained. Quenching increases the elastic limit but does not affect the modulus. Homopolar intermetallic alloys have a higher modulus, but these are nonmetallic in character and are usually fragile. The damping capacity (internal friction) and the electric conductivity of an alloy are very sensitive to changes in chemical composition and crystal structure. Unlike the modulus, the decrement is noticeably affected by impurities and small alloying additions and by cold-working. Homopolar-alloy compositions seem to possess the smallest damping capacities. Generally, any disturbance of the regularity of the crystalline lattice structure diminishes the damping capacity. Alloying, heat-treatment, or cold-work can be used to avoid dangerous resonance vibration stresses.

**Controlled Furnace-Atmospheres; Use of Paraffin Burners in New Wild-Barfield Equipment.** *Aircraft Production*, Vol. 9, No. 108, October, 1947, pp. 380, 381, illus.

Kerosene burners produce an atmosphere that prevents scaling and decarbonization of both high and low carbon-type steels. The atmosphere remains effective from 700 to 1,400° C. One gal. of fuel per burner will provide this atmosphere for approximately 24 hours.

## NONMETALLIC MATERIALS

**Plywood Panels in End Compression: Flat Panels with Grain at Various Angles to Direction of Loading.** W. Freiberger, F. S. Shaw, J. P. O. Silberstein, and R. C. T. Smith. *Australia, Council for Aeronautics, Report No. ACA-30*, January, 1947. 35 pp., illus. 12 references.

A summary of experimental and theoretical work on flat plywood panels. Orthogonal plywood panels were loaded along the grain of the outer veneers and at 45° to it; panels whose cores ran at 45° to the grain of the outer veneers were loaded at 22.5° to the outer grain. The buckling loads determined according to Southwell's method, as modified by Lundquist, and those determined from load vs. overall compression graphs, were in good agreement with theoretical investigations. Design data on the postbuckling behavior of the panels was obtained from empirical investigation.

**Plywood Panels in End Compression: Curved Panels with Grain at Various Angles to Generators.** J. P. O. Silberstein. *Australia, Council for Aeronautics, Report No. ACA-31*, January, 1947. 25 pp., illus. 5 references.

Tests covered two radii, three different types of plywood construction, and a large number of different sizes. Postbuckling behavior varied somewhat with the ratio of the sides. The square panel with the grain of the core at 90° to the grain of the veneer behaved rather like a slightly curved panel. Initial imperfections had a marked effect on the buckling loads. It was established that the buckling parameter could be expressed as the sum of a function of the bulge and the buckling parameter of the equivalent flat panel. It appeared that for highly curved panels, 22° panels are superior to orthogonal panels with grain of outer veneers at 0° or 45° to the generators, insofar as buckling stresses are concerned.

**Stability of a Few Curved Panels Subjected to Shear.** Edward W. Kuenzi. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1571*, May, 1947. 23 pp., diagrs.

Tests on plywood plates indicated that the buckling stress of a curved plate is approximately equal to the sum of the buckling stress of a complete cylinder subjected to torsion and the buckling stress of a flat plate, of the same size as the curved plate, subjected to shear. A test on a single plate of sandwich construction indicated that the theory for plywood can be extended to sandwich constructions. Curves show theoretical buckling coefficients of sandwich material.

**Buckling of Stiffened Flat Plywood Plates in Compression; A Single Stiffener Parallel to Stress.** C. B. Smith, L. A. Ringelstetter, and C. B. Norris. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1553-B*, May, 1947. 52 pp., illus.

A mathematical analysis of the critical stress of a plywood plate in edge compression which is stiffened by a single stiffener glued to the plate in a direction parallel to the stress. An approximate formula is obtained for the minimum stiffness required of the stiffener for it to remain straight when the panel buckles. Data from 532 tests performed on 58 panels indicate the need of an empirical factor to allow for an original lack of flatness of the plate.

**Mechanical Properties of Laminated Modified Wood.** E. C. O. Erickson. *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1639*, May, 1947. 35 pp., illus. 6 references.

A summary of test data and a preliminary evaluation of some of the basic mechanical properties of parallel-laminated and cross-laminated modified wood prepared from yellow birch, sweetgum, and Sitka spruce. Comparative values of specific strength based on strength-weight ratios indicated the marked advantage of normal laminate over the modified laminates in flexural strength and stiffness, and the advantage of the unimpregnated laminates over the resin-treated materials in tension parallel to the grain. The specific properties of wood are generally not improved by resin impregnation except for compressive properties and stiffness in crosswise tension. Such treatment of wood seems to be justified only where dimensional stability and other related properties are sought.

**Thermosetting Laminates; Laminated Plastics in Comparison with Conventional Materials; Some Examples of Successful Practice; Possibilities for Primary Structures.** G. R. Huisman. *Aircraft Production*, Vol. 9, No. 108, Ooctober, 1947, pp. 382–385, illus. 4 references.

Phenolic cotton-fabric laminates are low-strength materials that are not useful in aircraft construction for other than primary structures. Polyester glass-fabric laminates possess equivalent dielectric, chemical, and physical properties but have rigidity and strength and can be used in major aircraft structures.

**Creep, Long-Time Tensile and Flexural Fatigue Properties of Melamine and Phenolic-Plastics Materials.** D. Telfair, C. H. Adams, and H. W. Mohrman. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 7, October, 1947, pp. 789–793, figs. 9 references.

A comparison of the properties of commercial woodflour-filled phenolic and cellulose-filled melamine plastics, and of commercial asbestos-filled melamine plastics at standard conditions, 77°F. and 50 per cent relative humidity.

**Effect of Boiling for Various Periods of Time on the Strength of Joints in Birch Plywood Bonded with Urea Glue Fortified with Varying Amounts of Melamine and Resorcinol.** Sylvia M. Lecher. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1549*, December, 1946. 4 pp., tables.

Except for low concentrations of fortifiers, periods of boiling in excess of 12 hours are required to reduce the joint strengths of fortified urea glues below acceptable values. More than 12 hours of boiling would therefore be required to differentiate between such fortified urea glues and low-temperature phenol, melamine, or resorcinol glue.

**Stability of Low-Temperature-Setting Phenol, Resorcinol, and Melamine Resin Adhesives Stored at 80°F.** W. Z. Olsen and Leah Cohodas. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1532, Revised*, January, 1947. 7 pp., tables.

The best practical criterion of the stability of these glues appears to be the variation in working life. Stability should be defined in these terms, and resin-glue specifications should require

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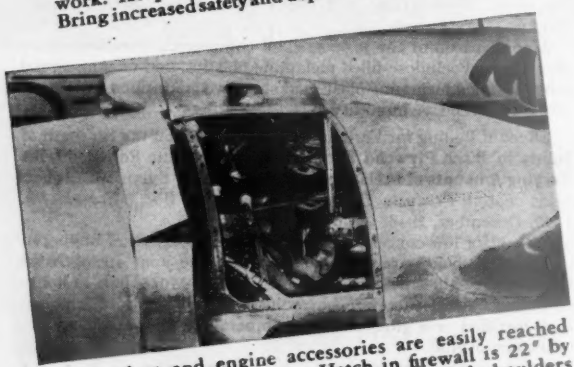

Power plant and engine accessories are easily reached through large access doors. Hatch in firewall is 22" by 24"—large enough to admit a man's head and shoulders—and gives access for servicing starter, generator, carburetor and other power plant accessories. Side opening facilitates major maintenance—saves time, cuts costs.

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that the glue be sufficiently stable to maintain a minimum working life for a prescribed period of storage.

**Synthetic Resin Glues.** *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1336, Revised,* March, 1947. 19 pp. A survey of the properties, uses, and methods of application of thermosetting and thermoplastic resin glues.

**Commercial Synthetic-Resin Glues.** *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1336-A,* January, 1947. 8 pp., tables.

A partial list of resin-glues on the current market and their manufacturers. Forty-one glues are listed alphabetically by trade name and manufacturer's designation. Information as to type, form, hardener or modifier, and general operating characteristics is tabulated for 151 glues. The data has been compiled from information supplied by the manufacturers, users, and the Forest Products Laboratory. The listing is not a recommendation of quality. The limits given for curing temperatures and other details have not in general been verified.

**The Use of "SR-4" Strain Gages in the Testing of Wood and Wood-Base Materials.** G. C. Ernst. *U.S., Forest Products Laboratory, Madison, Wis.,* 1947. 3 pp., illus.

## SANDWICH MATERIALS

**Sandwich Construction and Core Materials. I—An Introduction to Sandwich Construction.** F. T. Barwell. **II—The Preparation of Low-Density Materials for Use as Cores in Sandwich Construction.** N. E. Topp. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda Nos. 2123, 2124,* December, 1945. 15, 14 pp. diagrs. 5, 14 references. British Information Services, New York. $0.90, $0.90.

**I.** In structures subject to failure by elastic instability, weight can sometimes be saved by using a construction in which strong, stiff material is disposed at maximum distance from the neutral axis and the intervening space is occupied by a material of the lowest practical density. Some properties of available core materials and the three main methods of designing these structures are discussed. Comparison of sandwiches should be on a basis of the structure loading coefficient. Extensive theoretical work and the development of a range of core materials of various densities are necessary in order to obtain the optimum design for any given set of conditions.

**II.** A survey of the available low-density core materials and an analysis of their behavior and methods of production indicated that an expanded polymer should have a continuous closed-cell structure. Within limits, the properties of the material will not be affected by changes in bubble size. The specific stiffness of the expanded materials should approach two-thirds that of the parent material. Since this has not been achieved, it is assumed that there is a defect in the structure of the material or an inherent difficulty in the process, such as solvent retention.

**Resin-Treated Pulpboard Core Material for Sandwich Construction.** G. E. Mackin, R. M. Kingsbury, P. K. Baird, and E. C. O. Erickson. *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1623,* March, 1947. 42 pp., illus. 1 reference.

Core materials having the highest strength properties were prepared from pulpboards that contained a wide range of coarse and fine ground wood fibers and which were uniformly impregnated 40 to 50 per cent with an oil-modified phenol resin. The proper proportions of the different fiber sizes and orientation of the fibers in the pulpboards is more important than the type of phenol resin. The resin-impregnated pulpboard is superior to balsa wood in dimensional stability at high humidities and in resistance to decay organisms and moisture absorption. Its loss of strength is not as rapid as that of balsa when exposed to contact with moist soil or natural weathering.

**Buckling Loads of Flat Sandwich Panels in Compression; The Buckling of Flat Sandwich Panels with Edges Simply Supported (End Grain Balsa Cores and Facings of Aluminum and Glass Cloth Laminate).** K. H. Boller. *U.S., Forest Products Laboratory Madison, Wis., Report No. 1525-A,* February, 1947. 53 pp., illus. 16 references.

Tests to determine the critical buckling loads of flat sandwich panels with all edges simply supported, subjected to edgewise compression, were conducted to confirm the theoretical analysis given in *Forest Products Laboratory Report No. 1525.* Experimental values showed a reasonable agreement with values determined by substitution of the mechanical properties of the materials in the formula as it was modified to fulfill test conditions.

**Preliminary Report on the Strength of Flat Sandwich Plates in Edgewise Compression.** Kenneth H. Boller. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1561,* May, 1947. 29 pp., illus. 6 references.

The results of tests on sandwich constructions to determine the failing stress of the facing material, which is an important criterion in the determination of the suitability of the materials. Some of the mechanical properties of the core and facing materials and the methods used to obtain these data are reported.

**Durability of Low-Density Core Materials and Sandwich Panels of the Aircraft Type as Determined by Laboratory Tests and Exposure to Weather. I.** Bruce G. Heebink, William J. Kommers, and John J. Kunzweiler. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1573,* May, 1947. 54 pp., illus. 3 references.

Tests on core materials of balsa wood, cellular hard rubber, and cellular cellulose acetate showed that cellulose acetate had the best properties. Sandwich panels made by combining facing materials, aluminum, glass-cloth-resin, and plywood with the three core materials showed a weight gain upon immersion in water. The weight gain was controlled partly by the characteristics of the core and the face material and partly by the quality of the edge seal. Transverse dimensional changes under all exposures reflected the properties of the faces only. Changes for plywood were usually two to three times those of either glass cloth or aluminum.

**Stability of a Few Flat Sandwich Panels Subjected to Shear.** Edward W. Kuenzi. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1560,* May, 1947. 15 pp., illus.

Test results on specimens tested in frames with stiffness adequate to provide simply supported edges agreed well with theoretical predictions. The test value of the buckling stress depends on the relative stiffness of the loading frame. A panel that buckles at a stress below the computed value will buckle at a higher stress if the loading frame is reinforced. Consequently, it is questionable whether the designer can predict the edge conditions with sufficient accuracy to permit an accurate computation of the buckling stress even with a correct theoretical analysis.

**Sandwich Structures for Aircraft. What Research Promises.** Robert McLarren. **What Practice Shows.** Irving Stone. *Aviation Week,* Vol. 47, No. 18, November 3, 1947, pp. 28, 29, 31, 32, illus. 16 references.

# Meteorology

**Liquid-Water Content and Droplet Size in Clouds of the Atmosphere.** G. W. Brock. *American Society of Mechanical Engineers, Transactions,* Vol. 69, No. 7, October, 1947, pp. 769, 770, table. 7 references.

Theoretical calculations of liquid-water content of clouds and a summary of the data obtained in test flights. The instruments used (rotary cylinders, sooted slide, rotating disk, and porous cup) were specially designed at the A.A.F. Weather Service's Aeronautical Ice Research Laboratory to measure liquid-water content and droplet size.

**A Contribution to Help Explain the Atmospheric Pressure Distribution over the Atlantic Ocean.** H. Wagemann. (*Annalen der Hydrographie und Maritimen Meterorologie,* April–June, 1943.) *U.S., Army Air Forces, Library (Wright Field), Translation No. 407,* December 18, 1945. 10 pp.

Mean distribution of atmospheric pressure and air flow over the Atlantic Ocean shows a stationary wave motion. The wave is caused by the disturbance of a uniform west-east flow that results principally from the difference between the friction encountered over the land and that encountered over water. The low-pressure areas over land masses which develop as a result of this friction are intensified during the summer. The high-pressure areas over land are intensified in the winter.

**Wartime Developments in Applied Climatology.** W. C. Jacobs. *Meteorological Monographs,* Vol. 1, No. 1, August, 1947. 53 pp., illus., maps. American Meteorological Society, Boston. $1.00.

A collection of descriptive summaries of special weather studies made by the Army Air Forces Weather Service for strategic and planning purposes. The examples include problems of the effect of individual weather factors on materiel and equipment, and problems that were concerned with weather factors as they actually occur geographically and as they may be expected to

affect large-scale military operations. The wide variety of techniques employed shows the necessity of developing climatology as a field of study distinct from weather forecasting. Partial contents: Types of weather problems in staff planning; climatological techniques for military problems with reference to civilian application; climatology for forecasters; the accumulating, processing, and filing of basic climatological data; bases for a "synoptic" or "synchronous" climatology; problems associated with the presentation of climatic information.

**Diurnal Variations of Pressure and Temperature Aloft in the Eastern Caribbean.** Herbert Riehl. *American Meteorological Society, Bulletin*, Vol. 28, No. 7, September, 1947, pp. 311–318, figs. 6 references.

From 3-hourly special radiosonde observations, the diurnal pressure and temperature variation is computed for eight levels between the surface and 16 km. Considered corrections are applied for the effect of solar radiation on the radiosonde. Both pressure and temperature show large diurnal variations even in the high troposphere. These variations cannot be caused by horizontal convergence and divergence but by nonadiabatic processes aloft.

**Guided Propagation of Radar in Thunderstorm Conditions.** Richard D. Coons. *American Meteorological Society, Bulletin*, Vol. 28, No. 7, September, 1947, pp. 324–329, illus. An analysis of the unexpectedly large ground ranges, caused by tapping of radar propagation during afternoons of thunderstorm activity.

**Synoptic Aspects of the Intertropical Convergence Near Central and South America.** R. H. Simpson. *American Meteorological Society, Bulletin*, Vol. 28, No. 7, September, 1947, pp. 335–346, figs. 13 references.

A study based on meteorograph soundings, winds-aloft, and microanalyses of surface reports. When pronounced, this phenomenon consists of a relatively narrow zone of cyclonic wind shear and is frequently associated with a cold-core trough whose slope in the vertical is usually extremely variable in amount and intensity of activity. Wavelike perturbations that sometimes appear along this line of convergence are important in connection with cyclogenesis.

**Experimental Investigations Relating to the Formation of Ice Particles in the Atmosphere.** W. Findeisen and G. Schulz. (*Germany, Reichswetterdienst, Forschungs- und Erprobungsberichte, Series A, No. 27*, 1944.) *U.S., Army Air Forces, Library (Washington), Translation No. 387*, December 5, 1947. 45 pp.

Direct measurements of temperature, water content, and ice content made in various cloud formations, and laboratory tests, showed that ice formation in a cloud is a gradual process. The first solid particles form on a certain class of nuclei when a critical temperature is reached. As the temperature is further reduced, more and different atmospheric impurities act as nuclei. This first ice formation is a direct sublimation of the water vapor to a solid. The vertical velocity of the cloud mass determines the critical temperature required.

**Theory of Perturbations in Stratified Currents with Applications to Air Flow Over Mountain Barriers.** Paul Queney. *Chicago, University, Dept. of Meteorology, Miscellaneous Reports No. 23*, 1947. 81 pp., diagrs. $1.50.

**New Ceiling and Visibility Recorders.** *Aviation Week*, Vol. 47, No. 20, November 17, 1947, pp. 33, 34, illus.

The General Electric Company's Ceilometer automatically measures ceiling height by projecting vertically a pulsating light to the base of the clouds and then picking up the reflected light by a photoelectric cell. The angle at which the light pulse is intercepted is converted by triangulation into altitude and the result is recorded on a moving chart. The National Bureau of Standards' Transmissometer is a visibility recorder that consists of a light source and a photoelectric pickup. The received intensity of the light beam is translated into a measure of visibility.

**A Photoelectric Hygrometer.** Bernard Hamermesh, Frederick Reines, and Serge A. Korff. *American Meteorological Society, Bulletin*, Vol. 28, No. 7, September, 1947, pp. 330–334, diagrs.

An instrument that measures small absolute humidity variations by the photoelectric examination of the 9,440 Ångstrom-units absorption band of water vapor. The beam from a small light source passes through an airpath of less than 1.5 meters to a dispersing system. One vacuum phototube is centered at the 9,400 Ångstrom-units absorption band of water vapor in the spectrum that is produced. Another is centered on the 8,000 band where no water vapor absorption bands exist. As the water vapor in the air is varied, the phototube in the region of the absorption band is affected while the reference tube is not. A portable microammeter rather than a sensitive galvanometer is used to obtain indication. Humidity variations of 2 to 8 by $10^{-3}$ cm. of precipitable water in an air path of 143 cm. can be detected.

## Navigation

**Good News for Navigators.** Denning Miller. *Air Transport*, Vol. 5, No. 10, October, 1947, pp. 42, 80, table.

Description of H.O. 249, "Star Tables for Air Navigation." Tabulation is by local hour of Aries instead of by local hour angle of body; main argument is assumed latitude. By using the hour angle of Aries as the second argument, it is possible to make an across-the-page tabulation of computed altitude and true azimuth of any group of selected stars.

## Operations

### COMMERCIAL

**Douglas Surveys Airline Traffic Trends Between 1947 and 1950.** Charles Adams. *Aviation Week*, Vol. 47, No. 19, November 10, 1947, pp. 59, 60, table.

**Problems of Economy in Air Transport Relating to Navigation and Telecommunications.** Dudley Saward. *Shell Aviation News* (London), No. 11, September, 1947, pp. 7, 8.

**Foreign Air Lines of the World (Including United States Territories).** *Air Transportation*, Vol. 11, No. 4, October, 1947, pp. 60–63.

**Air Service Vital Problem in Germany.** *Aviation Week*, Vol. 47, No. 20, November 17, 1947, pp. 42, 45, map.

A survey of German domestic air transport. Stable policy and adequate mail-pay guarantees are proposed as necessary measures if America is to retain air-transport business in the American Zone of Occupation.

**U.S.-China Air Trade.** Kenneth N. Nynes. *Air Transportation*, Vol. 11, No. 4, October, 1947, pp. 10–14, 16, 17, illus.

A detailed analysis of the import and export trade between China and the United States. Taking present transport facilities and trade statistics as a basis, the balance of trade in those com-

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modities that are of sufficient unit value to warrant the added cost of air transport and are of such a nature that they would be made more valuable by speedy delivery would be heavily weighted in favor of China. However, the return haul problem would be difficult to solve.

**Planes for the Transport of China.** A. W. Jessup. *Air Transport*, Vol. 5, No. 10, October, 1947, pp. 43–46, illus.

History and current problems of the Chinese air-transport industry. Lack of communication and maintenance facilities and lack of passenger education present serious obstacles. Data on routes, costs, and rates are given.

**A Difficult First Year; Problems of British European Airways.** *Modern Transport*, Vol. 58, No. 1487, September 27, 1947, p. 7, tables. Survey and statistics of the operations of British European Airways from August, 1946, to August, 1947.

**Red Air Network.** Andrew Steiger. *Air Transport*, Vol. 5, No. 10, October, 1947, pp. 31–33, illus. Soviet air-route mileage in 1946 and 1947, passenger and freight air-transport network, airports, and a comparison of Soviet and U.S. fares.

**What Part Shall Freight Forwarders Have in the Development of the Air Freight Industry? II, III.** C. Allen Elggren. *Air Transportation*, Vol. 11, Nos. 3, 4, September, October, 1947, pp. 16–18, 30; 71–74, illus.

**Motaircargo Today.** John H. Frederick. *Distribution Age*, Vol. 46, No. 10, October, 1947, pp. 25, 59, 91, illus.

The proposed operations of Air Cargo, Inc., which has been established to conclude contracts with motor freight-forwarding agencies and to provide pickup and delivery service for air cargo at all points in the United States.

**Airfreight Creates Markets.** J. J. O'Brien. *Distribution Age*, Vol. 46, No. 10, October, 1947, pp. 50, 51, 90, 95, illus.

An account of the marketing problems solved by California Eastern Airways. New techniques in packing, materials handling, and refrigeration make air transport the most economical mode of shipment for many standard commercial items as well as those that are classed as luxury or emergency.

**Airfreight Saves Transportation Dollars.** Charles S. Baxter. *Distribution Age*, Vol. 46, No. 10, October, 1947, pp. 27, 71, illus.

The saving in weight and packaging costs on items that are shipped by air can result in substantial savings in gross transportation costs despite the higher net cost of air-cargo transportation.

**Two Decades of Air Express.** Robert G. McLain. *Air Transportation*, Vol. 11, No. 3, September, 1947, pp. 7–10, 32, illus. The facilities and services of the Railway Express Agency and the expansion of Air Express service.

**REA and Air Express.** *Distribution Age*, Vol. 46, No. 10, October, 1947, pp. 37, 38, 93, illus.

**Machinery by Air.** John H. Frederick. *Distribution Age*, Vol. 46, No. 10, October, 1947, pp. 40, 89, illus.

**Mechanical Handling Speeds Air Cargo.** Matthew W. Potts. *Distribution Age*, Vol. 46, No. 10, October, 1947, pp. 46, 76, illus.

**International Express and Mail Tables.** *Air Transportation*, Vol. 11, No. 4, October, 1947, pp. 64–69.

**International Air Transport Association Officially Approved Foreign Freight Forwarders.** *Air Transportation*, Vol. 11, No. 4, October, 1947, pp. 55–59.

### MILITARY

**Operational Flying.** F. M. A. Torrens-Spence. *Royal Aeronautical Society, Journal*, Vol. 51, No. 442, October, 1947, pp. 831–843, illus., Discussion, pp. 844.

A brief summary of some of the convoy and tactical operations carried out by aircraft carriers in the Mediterranean Theater from 1940 to 1942. An effective unit of sea power is no longer a single battleship but a collection of ships of different classes centered about the carrier. The employment of naval aircraft can be classified as defensive, offensive, protective, and "set-piece" (raiding a shore base). For each of these types of naval operation the carrier-based aircraft has shown itself to be intrinsically superior to land-based naval aircraft.

## Personnel

**Job Opportunities in Aviation.** Alice Rogers Hager. *Skyways*, Vol. 6, No. 12, December, 1947, pp. 34–39, 54, 56, 58, illus.

The listing includes only ground jobs in the aircraft manufacturing, engine, propeller, and accessory manufacturing, and the air-line branches of the industry. About 24 job titles are listed giving the duties, qualifications, required experience, salary range, and line of advancement.

## Power Plants

**Aircraft Propulsion.** F. M. Green and J. E. Wallington. *Institution of Mechanical Engineers, Proceedings*, Vol. 156, No. 2, 1947, pp. 176–185, diagrs., Discussion, pp. 185–194. (Cf. AER 3/47:57.)

**British Power Units; Pure Jet and Airscrew Turbine Designs; Piston Engines of All Sizes.** *Flight*, Vol. 52, No. 2020, September 11, 1947, pp. 267–271, illus. Descriptions and performance of 27 engines.

**Rolls-Royce Achievement.** *Rolls-Royce, Ltd., Publication No. TSD. 133*, 1947. 16 pp., illus. A brief pictorial history of the aircraft engines developed by Rolls-Royce, Ltd., from 1944 to date. World records made with Rolls-Royce engines are listed.

### JET & TURBINE

**Performance of Blowdown Turbine Driven by Exhaust Gas of Nine-Cylinder Radial Engine.** L. Richard Turner and Leland G. Desmon. *U.S., N.A.C.A., Report No. 786*, 1944. 11 pp., illus. 5 references. U.S. Govt. Printing Office, Washington. $0.15.

An investigation was made of an exhaust-gas turbine having four separate nozzle boxes each covering a 90° arc of the nozzle diaphragm and each connected to a pair of adjacent cylinders of a nine-cylinder radial engine. The engine power was decreased a maximum of 1 per cent by the presence of the turbine at the lowest turbine-outlet pressure as compared with the engine power delivered with a conventional collector ring discharging to an equal exhaust pressure. No engine-power loss was imposed by the presence of the turbine with turbine-outlet pressures greater than 20 in. of mercury absolute. The engine air-flow rate was not affected by the presence of the turbine. At an engine speed of 2,000 r.p.m. and an inlet-manifold pressure of 33.5 in. of mercury absolute, the turbine power varied from 9 per cent of engine power with a turbine-outlet pressure of 28 in. of mercury absolute to 21 per cent of engine power with a turbine-outlet pressure of 7.5 in. of mercury absolute.

**The Ram-Jet Engine; Severe Operating Conditions Intensify Design Problems.** Eugene Perchonok. *Machine Design*, Vol. 19, No. 10, October, 1947, pp. 92–94, illus.

Although the efficiency of the ram-jet increases directly with the cube of its forward velocity, the high temperatures and pressures at which it must operate and the difficulty of designing a variable-area inlet diffuser and an exhaust nozzle at present make its application to aircraft propulsion impractical.

**Concentration on Jet Research Expected to Yield Greater Gains; Allison Director of Engineering Sees More Benefits to Be Obtained from Funds Spent on Turbine Development.** *Aviation Week*, Vol. 47, No. 20, November 17, 1947, pp. 29, 30, 34, figs.

**An Aircraft Gas Turbine for Propeller Drive.** Alan Howard and C. J. Walker. *Mechanical Engineering*, Vol. 69, No. 10, October, 1947, pp. 827–835, illus.

A detailed description of the components of the G-E TG-100 gas turbine and a résumé of its development during the test program. Expected performance is compared with test results. Current development is directed toward mitigation of the deterioration in performance which follows upon continuous operation.

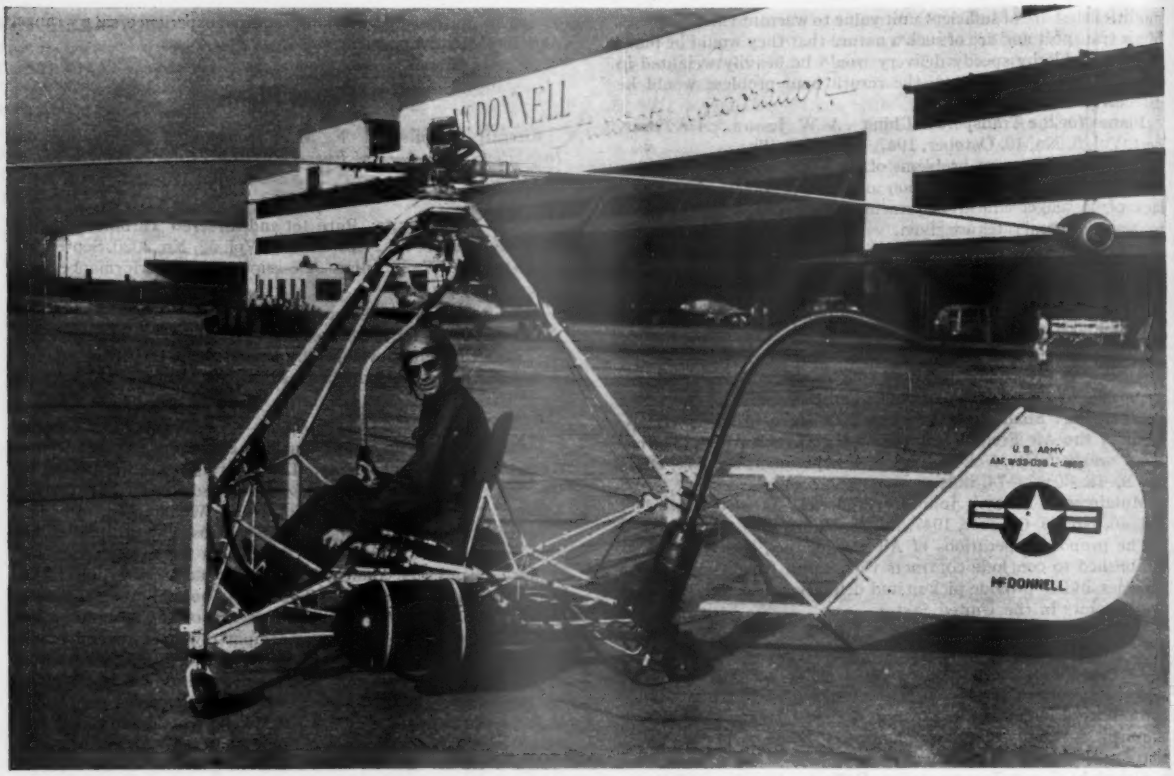
**Marauder to Carry French Jet Engine (Rateau SRA Axial-Flow Turbojet).** *Aviation Week*, Vol. 47, No. 18, November 3, 1947, pp. 45, 47. Includes brief notes on four other French jet engines.

**Armstrong Siddeley ASX and Python Gas Turbines.** *Shell Aviation News* (London), No. 11, September, 1947, pp. 23, 24, diagrs.

**National Gas Turbine Establishment; Increased Activity and Expanding Facilities.** *Flight*, Vol. 52, No. 2022, September 25, 1947, pp. 353.

**The National Gas Turbine Establishment.** *The Aeroplane*, Vol. 73, No. 1895, October 3, 1947, pp. 473, 474, illus.

**Recent Development in the Design of Kaplan and Francis (Hydraulic Reaction) Turbines.** H. W. Hamm. *U.S., Field Information Agency, Technical Final Report No. 966*, January 16, 1947. 50 pp., illus. 8 references. British Information Services, New York. $1.60.




**The Army's first ram-jet helicopter, developed by McDonnell Aircraft Corporation, has been undergoing successful flight tests during the past 6 months.**

## RECIPROCATING

**Preboiling Evaporation Losses in Aircraft Fuel Tanks.** L. M. Whitney, F. G. Bollo, and A. G. Cattaneo. *Journal of the Aeronautical Sciences*, Vol. 14, No. 12, December, 1947, pp. 703–706, figs. 4 references. (Cf. AER 5/47:26.).

**Piston Cooling.** H. R. Ricardo. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2173*, November, 1947. 9 pp., diagrs. British Information Services, New York. $0.60.

Experimental results show that efficient oil cooling can be provided for pistons in light high-speed engines. The use of the crankpin as a rotary valve appears to be the best way of timing the delivery of the coolant oil. Piston cooling can be effected without taking the required cooling oil from the big-end bearing and without bleeding oil from the highly loaded zones if the oil used for cooling the piston has first lubricated and cooled the big-end bearing. The quantity of oil circulating through the piston can be determined entirely by the admission period at the crankpin. In the V-type engine, where two connecting rods per crankpin are used, one outlet oil hole must be provided for each rod.

**Preknock Vibrations in a Spark-Ignition Engine Cyclinder As Revealed by High-Speed Photography.** Cearcy D. Miller and Walter O. Logan, Jr. *U.S., N.A.C.A., Report No. 785*, 1944. 20 pp., illus. 9 references. U.S. Govt. Printing Office, Washington, $0.20.

The high-speed photographic investigation of the mechanics of spark-ignition engine knock recorded in three previous reports has been extended with use of the N.A.C.A. high-speed camera and combustion apparatus with a piezoelectric pressure pickup in the combustion chamber. The motion pictures of knocking combustion were taken at the rate of 40,000 frames per sec. Existence of the preknock vibrations in the engine cylinder suggested in *Report No. 727* has been definitely proved, and the vibrations have been analyzed both in the high-speed motion pictures and the pressure traces. Data are also included to show that the preknock vibrations do not progressively build up to cause knock. The effect of tetraethyl lead on the preknock vibrations has been studied, and results of the tests are presented. Photographs are reproduced which in some cases clearly show evidence of autoignition in the end zone a considerable length of time before knock occurs.

**The Effect of Humidity on Piston Engine Performance.** H. W. Slade. *Shell Aviation News* (London), No. 11, September, 1947, pp. 18–20, diagrs.

High atmospheric humidity results in a displacement of some of the air by water vapor and an enrichment of the mixture. In rich-mixture operation, this causes a loss of power and, in lean-mixture operation, a gain in power. Take-off loss of power can be offset by an increase in the boost pressure, which is permissible because of the antidetonation properties of the water-vapor additive.

**Fuel Injection for Lightplanes.** George H. Tweney. *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 54–56, 119, diagrs.

Fuel injection in reciprocating engines gives better fuel economy over a wider range of fuels, permits higher compression ratios, and provides more flexible engine operation than the carburetor manifold system. Fuel-injection engines that use spark ignition, in contrast to combustion ignition, require less maintenance, operate over a wider load range without exhaust smoke, have a wider fuel range, and start more easily. The factors that affect the design of this type of engine in general and for use in light aircraft are enumerated.

**Metallurgical Examination of Fuel Tank from Japanese Aircraft "Oscar."** C. A. Reichelderfer, J. M. Blalock, and H. W. Gillett. (U.S., Office of Scientific Research and Development, National Defense Research Committee.) *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./1481*, June 24, 1944. 8 pp., illus. British Information Services, New York. $0.55. A report of chemical and physical analyses. The tank was constructed of aluminum sheet, aluminum extrusions, and brass and steel fittings. It was assembled by riveting and welding.

**Metallurgical Examination of Four Different Types of Japanese Aircraft Spark Plugs.** L. H. Grenell, J. R. Cady, and others.

(U.S., Office of Scientific Research and Development, National Defense Research Committee.) *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./1488*, August 5, 1944. 8 pp., illus. British Information Services, New York. $0.55.

Materials, design, and manufacture of four types of spark plugs. All samples were of mica construction. Copper, brass, and low-carbon steel bushings were used as thermal conductors between the central electrode and the spark-plug case.

**Light Weight, Small Size Claimed for 2-Cycle Diesel Barrel Engine.** T. L. Sherman. *SAE Journal*, Vol. 55, No. 10, October, 1947, pp. 49–53, illus., diagrs. (Extended abstract of a paper: "Slant Mechanism—Its Fundamentals and Application to Diesels for Aircraft and Other Low-Weight Fields.")

Design analysis of a slant opposed-piston Diesel aircraft engine. Design is a development of a crankless engine invented by A. G. M. Mitchell of Melbourne, Australia. 1,600 b.hp. at 1,800 r.p.m. has been obtained in steady operation.

**German Radiator and Oil-Cooler Construction (Project No. DP-156).** Sidney S. Brody. *U.S., Army Air Forces, Summary Report No. F-S U-1148-ND*, September, 1947. 19 pp., illus. 4 references.

An overall picture of wartime design and manufacturing methods. Includes a survey of flattened-tube and fin-type radiators, flattened-tube radiators with integral fins, honeycomb radiators, press welding, the shaving process, the Zarges brazing process, high-pressure oil coolers, and aluminum cleaning and soldering.

**Soviet Aero Engines; A Compendium of Russian Aero Engines, Compiled from Polish Sources and Showing the Aircraft in Which These Engines Are Fitted.** *Aeronautics*, Vol. 17, No. 3, October, 1947, pp. 54, 55, tables. Includes a table of specifications and performance characteristics of 18 reciprocating engines.

### ROCKET

**Lagrange's Equations for a System of Variable Mass.** Derek F. Lawden. *British Interplanetary Society, Journal*, Vol. 6, No. 6, September, 1947, pp. 174–178.

Boundary conditions must be assigned in a way such that a rocket may be regarded as a typical dynamical system of variable mass. Equations of virtual work are derived to show the modifications which must be made to Lagrange's equations before they can be applied to a system of variable mass that is holonomic and possesses $n$ degrees of freedom. Two forms of the equations are obtained; one is suitable for most systems into which matter is being assimilated, and the other suitable for systems from which matter is being ejected.

## Production

**Airframe Production; A Review of Wartime Manufacture by the British Aircraft Industry. II—Actual Production Methods and Results; Labour Efficiency and Costs; Overall Production Costs.** Eric Mensforth. *Aircraft Production*, Vol. 9, No. 108, October, 1947, pp. 388—395, figs. 6 references. (Cf. AER 11/47:53.)

**Latin America's Growing Aircraft Industry.** George M. Galster. *Automotive Industries*, Vol. 97, No. 8, October 15, 1947, pp. 24–26, 62, 64, 67, illus.

A survey of the aircraft manufacturing industry in Mexico and South American countries. Native designs are principally of the personal plane type and exploit the use of native woods. Low labor costs make the native production of entire aircraft and of components and accessories profitable and point to the ultimate development of self-contained indigenous industries.

**A New Technique in the Construction of Major Assembly Jigs.** Donald Paterson. *Sheet Metal Industries*, Vol. 24, No. 246, October, 1947, pp. 2035–2040, 2046, illus.

A. V. Roe and Co., Ltd., have used Cerromatrix, a bismuth-rich noneutectic alloy containing tin, lead, and antimony, for the setting of important location points. The jig fixtures are accurately positioned and the molten alloy flows into the space between the fixture and the frame. The alloy expands on hardening and forms a rigid bond that permanently locates the fixture. If a jig frame is distorted during moving, and repositioning of the fixture is necessary, the alloy can be melted, the fixture adjusted, and a new Cerromatrix seal poured.

**A Monograph on Brazing of Steel.** S. L. Case. (Battelle Memorial Institute.) *U.S., Army Air Forces, Technical Report No. 5602*, January 15, 1947. 290 pp., illus.

A comprehensive treatise on brazing. The basic data were obtained in the course of research to determine the brazing qualities of various alloys and the relative merit of variations in brazing processes. Both the capillary-rise method and the maximum bubble-pressure method of measuring surface tension were used to evaluate the wettability of a base metal by a brazing alloy. Investigation of the nature of the bond, the film thickness of filler metal, and the origin, detection, and effect of voids, provided criteria on which the strength tests of specimen joints were set up. The tests comprised filleting, tensile, fatigue, impact, and creep tests and radiographic and metallographic examinations. The significant data from each type of test are carefully evaluated because they are of limited applicability, since laboratory conditions approach the ideal. The immediate object of the research was the development of alloys for the brazing and filleting of hollow steel propeller blades. A high-temperature copper-manganese alloy, superior to oxygen-free high-conductivity copper, was developed. Its liquidus temperature of 1,760°F. permitted normalizing of the filleted blades. Silver-copper-zinc alloys were found which could be used in the intermediate temperature range, 1,250°–1,600°F.; thus brazing could be accomplished during hardening treatment. Further reduction of the liquidus to near 1,130°F. was obtained by the addition of cadmium and gold. In this low-temperature range, it was possible simultaneously to braze and temper steel propeller blades. A final phase of the study investigated the practicability of soft-solder type of alloy which could be used at temperatures less than 600°F. and applied to the propeller as a final process. Cadmium-base was found to be sufficiently malleable but to have critical wettability and to require careful fluxing.

**The Effect of Preheating and Postheating on the Quality of Spot Welds in Aluminum Alloys.** W. F. Hess, R. A. Wyant, and F. J. Winsor. *U.S., N.A.C.A., Technical Note No. 1415*, November, 1947. 20 pp., figs. 4 references.

Results of tests show that a slowly rising condenser-discharge preheat current with a rapidly rising welding current afforded no less expulsion than a rapidly rising welding current alone, and was inferior to a slowly rising welding current alone. In one case using slowly rising current for preheating and welding proved beneficial, although, generally, utilizing a raised electrode welding force to decrease expulsion was more practicable. Postheating had no effect on shear strength until the current was sufficient to remelt the welds, which greatly increased the weld diameter and shear strength.

**Observations of Electrode Tip Pickup and Tip Life in the Spot Welding of Magnesium Alloy Sheet.** W. F. Hess, T. B. Cameron, and R. A. Wyant. *The Welding Journal*, Vol. 26, No. 8, August, 1947, pp. 433-s–442-s, 484-s, illus. 10 references.

An investigation of the optimum condenser-discharge welding conditions and the physical properties of spot welds in selected tempers and gages of sheet magnesium which are available commercially. The data compiled provide methods of evaluating the useful life of an electrode tip; compare the tendency to cause pickup of the differing composition of the sheets; show the influence of preweld cleaning method, surface resistance, and weld size on tip life; and indicate the importance of the direction of the welding current and the effect of pickup on the soundness of the welds.

**Design for Flash Welding.** Harry W. Brown. *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 82, 85, 86, 89, 94, illus. Basic design of flash-welded assemblies, particularly tubular parts, and a résumé of specifications.

**Standard-Unit Tooling; A Practical System for a Jig and Fixture Assembly from Stock Parts.** *Aircraft Production*, Vol. 9, No. 108, October, 1947, pp. 378–380, illus.

**Report on the Bristol Brabazon; Inner-Wing Riveting; Leading-Edge Structures; Power-Unit Bays; Component Manufacture and Assembly.** *Aircraft Production*, Vol. 9, No. 108, October, 1947, pp. 370–377, illus. (Cf. AER 7/47:57.)

**Bending Spar Booms; American Technique for Handling Tough Alloy of Heavy Section; Resistance-Heating in Press.** *Aircraft Production*, Vol. 9, No. 108, October, 1947, p. 369, illus.

Ryan Aeronautical Company used resistance heating to obtain a material temperature of 300°F. in order to bend spar booms of alloy 75S-T with a cross section of 7 sq. in. At this temperature two separate operations were performed, one to produce the sweepback and the other to give the dihedral.

**Casting Magnesium in Metal Molds.** Herbert Chase. *The Iron Age*, Vol. 160, No. 13, September 25, 1947, pp. 73–76, illus.

Description of practice employed at Bendix Aviation Corporation, Teterboro, N. J., in producing parts as die castings and in permanent and semipermanent molds. A new alloy, Eclipsaloy 130, contains 1–1.5 per cent aluminum, 0.5 per cent minimum of manganese, and the rest magnesium.

**Forging Aluminum and Magnesium on a Giant Hydraulic Press.** Ralph Moore and J. R. Douslin. *Machinery*, Vol. 54, No. 2, October, 1947, pp. 135–141, illus.

A description of the methods used in the manufacture of aluminum gas-turbine impellers and magnesium base plates at the R.F.C. plant (Wyman Gordon Products Corporation) for experimental development and production of large light-metal forgings.

**Automatic Milling Machines Solve Spar Cap Production Problem at Douglas.** V. C. Fergen and C. R. Wulffsohn. *Automotive Industries*, Vol. 97, No. 8, October 15, 1947, pp. 38–40, illus.

A description of some of the machining operations used at the El Segundo plant of the Douglas Aircraft Company, Inc. The machining from single billets of large parts for the AD-1 Skyraider presents problems on quantity production because of the large quantity of material which must be removed and the complexity of the cuts required.

**Machine-Shop Operations in Producing Light Aircraft-Engine Crankshafts.** M. F. Colburn. *Machinery*, Vol. 54, No. 2, October, 1947, pp. 146–150, illus.

**Turbine-Blade Milling; New Hydraulically Controlled Machine by Sulzer.** *Aircraft Production*, Vol. 9, No. 108, October, 1947, p. 381, illus.

**An Experiment in the Use of a Standard Limit System.** John Loxham. *Institution of Mechanical Engineers, Proceedings*, Vol. 156, No. 2, 1947, pp. 103–112, diagrs., Discussion, pp. 112–125.

Recommendations for modification of the British Standard Specification, "Limits and Fits for Engineering," which can be used only for about 70 per cent of the tolerances met in actual practice.

**Production Points at Radlett; Some Notes on Recently Developed Equipment and Processes.** *Aircraft Production*, Vol. 9, No. 108, October, 1947, pp. 363–368, illus.

**Solid Carbide Boring Bars.** *Iron Age*, Vol. 160, No. 17, October 23, 1947, pp. 44, 45, illus.

The rigidity of solid carbide reduces chatter and makes it possible to bore holes with length-diameter ratios as high as 8 to 1. The proper selection of either single or tandem bits allows a specified surface finish to be produced without further processing.

**Composite Dimensioning Speeds Production and Inspection.** J. T. Bennett. *Product Engineering*, Vol. 18, No. 10, October, 1947, pp. 141–143, diagrs.

## Propellers

**Propeller Development; The Background of Type-Approval.** Dudley Russell. *De Havilland Gazette*, No. 40, August, 1947, pp. 4–7, illus.

A detailed description of the test program to which a propeller and its auxiliary equipment must be subjected before final type approval can be obtained. The tests include specific tests of individual components, static testing of subassemblies, and vibration and flight testing of the entire assembly.

**Automatic Props Improve Light Plane.** John D. Waugh. *SAE Journal*, Vol. 55, No. 10, October, 1947, pp. 40–43, illus. (Extended abstract of a paper: "Evolution of an Automatic, Variable-Pitch Propeller.") (Cf. AER 6/47:52).

**German Propellers for Aircraft and Marine Craft; Interrogation of Professor Tietjens on 3rd February, 1947.** *Gt. Brit., British Intelligence Objectives Subcommittee, Final Report No. 1337*, February 3, 1947. 3 pp. British Information Services, New York. $0.35.

**Britain's Airscrews.** *The Aeroplane*, Vol. 73, No. 1891, September 5, 1947, pp. 325–327, illus.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## Rotating Wing Aircraft

**Two New European Designs.** Jan Hirsch. *American Helicopter*, Vol. 8, No. 11, October, 1947, p. 22, illus.

The Praga E-1, designed by the Czechoslovakian aeronautical engineer Slechta, is of the intermeshing two-bladed rotor type. The engine is a specially designed vertical flat four 100-hp. Praga M-107. Hydraulic power is used to tilt the axis, rotor, and engine as one unit. A Belgian design by Florine uses four three-bladed rotors that are disposed in a square and are mounted on four pylons extending from the fuselage. Vertical and horizontal tail surfaces provide directional stability.

**West Coast Helicopter Builders Press Work on Four Designs; Hiller, Landgraf, Magill and Pentecost Near Flight Testing of Latest Models, Although Production Plans Not Clarified.** Scholer Bangs. *Aviation Week*, Vol. 47, No. 20, November 17, 1947, pp. 18, 21.

**Rotating-Wing Aircraft; Variety of British Types in Course of Development.** *Flight*, Vol. 52, No. 2020, September 11, 1947, pp. 289, 290, illus.

**Helicopter Developments; Igor Sikorsky on Recent Achievements and Future Prospects.** *Flight*, Vol. 52, No. 2021, September 18, 1947, pp. 336, 337, illus.

**Introducing the Bell 47B; Hardy Two-Seater Helicopter Demonstrated by New British Company.** *Flight*, Vol. 52, No. 2022, September 25, 1947, pp. 347, 348, illus.

**The Brantly Helicopter (With Two Three-Bladed Coaxial Rotors).** *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 62, 63, 117, 118, illus. (Cf. AER 6/47:53.)

**The Landgraf H-2 Helicopter.** *The Aeroplane*, Vol. 73, No. 1896, October 10, 1947, p. 495, illus.

**Movable Cabin Controls Helicopter; By Shifting C.G. in Flight, a Simpler Rotor Assembly is Possible; (Designed by Charles Seibel).** *Aviation Week*, Vol. 47, No. 18, November 3, 1947, pp. 22, 25, 27, illus. (Cf. AER 11/47:48.)

**The (Sznycer-Gottlieb) SG Mark VI Flies.** M. Berry. *American Helicopter*, Vol. 8, No. 11, October, 1947, pp. 8, 9, 24, illus. (Cf. AER 11/47:48.)

**Dutch Inventer Designs Helicopter to Loop.** *Aviation Week*, Vol. 47, No. 19, November 10, 1947, p. 22. Some details of prospective twin-rotor craft designed by E. Van Dijk.

**'Copter Maintenance Is Meticulous. . .But Not Much Different.** David G. Forman. *Air Transport*, Vol. 5, No. 10, October, 1947, pp. 36, 37, illus.

**Electric Motor Whirl Test of Three-Blade 8 Ft. 5 In. Sikorsky XR-5 Helicopter Auxiliary Rotor Equipped with Stainless Steel Leading Edges.** T. R. Pierpoint. *U.S., Army Air Forces, Technical Report No. 5217, (Whirl Test No. 1944)*, March 31, 1945. 56 pp., illus.

**Air Mail Cost Forecast.** George Wales. *American Helicopter*, Vol. 8, No. 11, October, 1947, pp. 17, illus.

A summary of the proposed routes and operating methods to be used by United Air Lines in conducting a helicopter mail service in the Chicago metropolitan area. A tabulated estimate of costs is taken from the exhibits filed with the Civil Aeronautics Board.

## Safety & Rescue

**Improved Protective Design Offers Lightplane Safety Hope.** *Aviation Week*, Vol. 47, No. 19, p. 14, illus.

Data collected by Crash Injury Research have shown that certain safety features incorporated in aircraft designs have prevented personnel injuries. Injury to personnel can also be prevented by designing structural units to fail progressively, by designing cabins to buckle outwards, away from the occupants, and by installing an instrument panel and wheel of ductile metal to cushion the impact of the pilot in a crash.

**Aircraft Rescue and Fire Fighting. I.** *Airports*, Vol. 12, No. 3, September, 1947, pp. 20–23, illus.

The National Fire Protection Association's standard operating procedure for crash and fire-fighting crews at an airport. The procedures gives first priority to the rescue of personnel and assigns secondary importance to the extinguishing of the fire.

**Aircraft Fire Extinguishing.** David H. Moore, Jr. *Aero Digest*, Vol. 55, No. 3, September, 1947, pp. 44–45, 114, 115, diagr. 8 references.

A brief outline of the factors that must be considered in the design of aircraft fire-extinguishing systems. The rate of discharge and the duration of discharge of the extinguishing agent depends on the location of the fire, the characteristics of the combustible material, and the local air blast and its turbulence. A list of

common fire hazards emphasizes the necessity of designing for fire prevention instead of fire control. Special factors must be taken into account for jet installations.

**Test Facilities: Aircraft Fire Protection Program.** H. L. Hansberry. *U.S., Civil Aeronautics Administration, Technical Development Report No. 54,* July, 1947. 18 pp., illus.

Sources of ignition, optimum design criteria to reduce fire hazard, and fire detectors will be investigated. A wind tunnel provided with photographic and pyrometric recording equipment will allow the full-scale testing of power-plant installations under simulated flight conditions. There will be a special building for the study of the fire protection of jet engines.

**Rescue Requirements.** John H. Frederick. *Southern Flight,* Vol. 28, No. 4, October, 1947, pp. 26, 33.

## Sciences, General

### DYNAMICS

**Note on the Dynamics of a Slightly Deformable Body.** W. S. Hemp. *College of Aeronautics, Cranfield, England, Report No. 5,* February, 1947. 5 pp.

A mathematical description of the motion of a slightly deformable body. The equations governing this motion are formulated and the basic method used by Lamb is developed for the special case in which the deformation is small. The motion is separated into three parts, translation, rotation, and vibration. Translation is shown to be independent of the other two motions, but rotation and vibration are shown to be coupled except in the case in which both of these motions are small.

### MATHEMATICS

**Technique of the Step-by-Step Integration of Ordinary Differential Equations.** W. J. Duncan. *College of Aeronautics, Cranfield, England, Report No. 4,* February, 1947. 25 pp., tables. 22 references.

The error in the approximate solution for a given range of the independent variable is a function of that variable and the number of equal steps $n$ used in obtaining the solution. The index of a step-by-step method of solution is defined as the lowest power of the reciprocal of $n$ which appears in the expressions for the errors at the end of the total interval of integration when these are expanded as an infinite power series in the reciprocal of $n$. By choosing two appropriate values for $n$ it is possible to obtain two simultaneous equations for the error in the final term which are soluble with close approximation. A chart shows the classification of methods of numerical integration. The method, its accuracy, and its applications are briefly described.

**Mechanical Instruments for Solving Linear Simultaneous Equations.** R. A. Fairthorne. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2344,* August, 1944. 7 pp. 11 references. British Information Services, New York. $0.45.

A review of the mechanical instruments that have been used for the direct solution of linear simultaneous equations. The principles that have been used range from nomography to hydrostatics. While almost any mechanical principle can be employed, the instrument can be successful only if it is treated as a major engineering project. Since the practical limit of the value of any instrument is the time required to set up the coefficients, an electrical system seems superior to any mechanical device. Projection and motion-picture technique offers a possible means of extending the principles of multiplane nomography.

**Note on the Use of Symmetric Functions in the Solution of Linear Differential Equations with Constant Coefficients.** Martin Goland and Y. L. Luke. *Franklin Institute, Journal,* Vol. 244, No. 3, September, 1947, pp. 221–223. 2 references.

**A Least-Square Application to Relaxation Methods.** O. L. Bowie. *Journal of Applied Physics,* Vol. 18, No. 9, September, 1947, pp. 830–833, diagrs. 4 references.

A method by which the mean-square error is minimized in the correction of a given set of values obtained by applying the least-square to the relaxation technique. The method provides a systematic procedure for weighting errors at various points of the lattice. It has general applicability to various forms of equations and definitions of corresponding difference equations. Laplace's and the biharmonic equations are used to illustrate the method.

**New Proofs of the Theorems of Kasner Concerning the Infinitesimal Contact Transformations of Mechanics.** John De Cicco. *Journal of Mathematics and Physics,* Vol. 26, No. 2, July, 1947, pp. 104–109. 5 references.

These theorems deal with the nature of two dynamical systems each of which have the same number of degrees of freedom and for which the commutator or alternant of the associated infinistesimal contact transformation is a point transformation. The proofs show that this situation can only come about when the expressions for the kinetic energy are the same, or differ by a factor that depends only on the $n$ generalized coordinates. The converse of this proposition is also proved to be valid: that two infinitesimal contact transformations with the same transversality law will have a point transformation for commutator if, and only if, they are associated with two dynamical systems of this type.

**On Spheroidal Wave Functions of Order Zero.** C. J. Boukamp. *Journal of Mathematics and Physics,* Vol. 26, No. 2, July, 1947, pp. 79–93, Tables. 31 references.

A method is developed for obtaining the characteristic values of linear second-order differential equations of the type in which the coefficients occurring in the development of the characteristic functions are determined by a three-term recursion formula. This method was developed in an attempt to obtain characteristic values of high accuracy and at the same time avoid the cumbersome iteration of previous methods. The method leads directly from two-decimal accuracy to six-decimal accuracy. The tabulated data on spheroidal wave functions of order zero and of the first order supplement earlier American tables of separation constants and coefficients. This method is the same as one that was developed independently by Gertrude Blanch in her work on Mathieu's equation, and it was originally published in a Dutch thesis.

## Seaplanes & Flying Boats

**Recent Developments in Flying Boats.** Henry Knowler. (The 19th Thomas Lowe Gray Lecture.) *Institution of Mechanical Engineers, Proceedings,* Vol. 156, No. 2, 1947, pp. 89–102, diagrs., 8 pp. plates. (Cf. AER 4/47:67.)

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**The Flying Boat; Some Problems in Fitting It Into the Transport Picture; The Question of Bases.** David Brice. *Flight*, Vol. 52, No. 2024, October 9, 1947, pp. 408, 409.

## Stress Analysis & Structures

**Cardboard-Box Wing Structures.** F. R. Shanley. *Journal of the Aeronautical Sciences*, Vol. 14, No. 12, December, 1947, pp. 713–715, illus. 2 references.

A metal structure consisting of two sheets joined by another corrugated sheet was found to resist bending in any transverse plane. It is more efficient to support such a panel along the edges than to break it up into short spanwise lengths by ribs. This requires the revision of basic design ideas and the replacement of ribs by spanwise "shear" beams or spacers. The same reasoning applies to thick-skinned wings in which the plate is heavy enough to be used without auxiliary stiffeners. Allowable stress is not a direct measure of strength-weight efficiency. The only sure basis of comparison is a weight estimate of the entire wing structure on a constant strength basis. This might show that the wing having the lower allowable stress is actually lighter because more material is working than in conventional design. Relatively high curvature, such as that of a leading edge, has roughly the same general effect as narrow panel width. Sandwich construction can often be used for such elements without any further stiffening members. The development of lighter types of core material should permit the efficient use of sandwich construction in fuselages where the larger radius of curvature requires a large effective shell thickness to prevent buckling.

**Stress Analysis of Noncircular Rings for Monocoque Fuselages.** Chi-Teh Wang and S. Ramamritham. *Journal of the Aeronautical Sciences*, Vol. 14, No. 12, December, 1947, pp. 707–712, diagrs. 7 references. (Cf. AER 7/47:28.)

**Mechanical Admittances and Their Application to Oscillation Problems.** W. J. Duncan. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2000 (Monograph)*, 1947. 128 pp., diagrs. 45 references. British Information Services, New York. $5.90.

A treatise on dynamic flexibility. Dynamic flexibility or mechanical admittance is the ratio between the amplitude of displacement to the amplitude of a simple harmonic force that acts on a mechanical or structural system. This ratio, which can be computed for the elements of complex mechanical systems, provides a simple means of determining the response of the system to simple harmonic forces and the natural frequencies of the system. The exact method of calculating admittances of continuous deformable bodies, which is applicable only to special simple cases, is described, as well as the representation of the deformable body, by discrete masses elastically connected, and by Lagrange's and Galerkin's methods, which are approximate treatments with more extensive application. The concept of admittances is extended to systems subject to pure damping actions, gyrostatic systems, and aerodynamic systems. The experimental determination of admittances is briefly described, together with the theory of resonance tests, the measurement of direct admittances, and the measurement of cross admittances. The mathematical methods permit the calculation of admittances for a range of frequencies up to the first overtone of the system. The concept and methods outlined were developed for, and find particular application in the study of vibration of aircraft power plants. Admittances facilitate the splitting of complicated problems on mechanical vibration into manageable portions that can be investigated separately. In this way the range of tractable problems is extended even if no problem is solved which is not, in theory, soluble without using admittances. It is usually possible to frame a general solution to a class of problems even when the values of the individual admittances are unknown.

**The Wrinkling of Sandwich Struts.** F. T. Barwell and J. R. Riddell. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2143*, June, 1946. 11 pp., illus. 11 references. British Information Services, New York. $0.75.

Experiments were conducted on a range of sandwich struts composed of steel and expanded formvar in order to determine their crippling loads under the wrinkling type of failure and to compare these results with theoretical work. Since a determination of Young's modulus of the core material in compression in the transverse direction and in the longitudinal direction showed that expanded formvar cannot be considered to be even approximately isotropic, no direct comparison could be made with the Gough, Elam, and de Bruyne analysis, which assumes isotropic core material. Over the range of struts tested, the Cox expression gives an almost constant value for the wrinkling stress as the skin thickness varies. This value is about 16 per cent less than the mean value obtained in the experiments. This may be explained by the possibility that the core material used in the experiments may not have been uniform throughout its thickness.

**On the Buckling of Elastic Rings.** G. F. Carrier. *Journal of Mathematics and Physics*, Vol. 26, No. 2, July, 1947, pp. 94–103, figs. 5 references.

Four problems in the theory of stability and the theory of elasticity. Solutions are indicated for the elastic problem of thin circular rings under uniform radial pressure, the problem of closed symmetric rings under loading (which produces a stability problem), the stability problem of a ring that has been prestressed into a configuration with large deflections, and the stability of a ring subjected to a uniform pressure applied harmonically in time.

**Computer for Principal Stresses.** R. G. Manley. *Engineering*, Vol. 164, No. 4263, October 10, 1947, pp. 340, 341, diagrs.

The computer is designed to deal with rectangular-rosette readings. It consists of two horizontal slides, one vertical slide and three cursors; one of the cursors carries a radius arm and a protractor. The substitution of different sets of slides makes it possible to evaluate the principal surface stresses either from apparent-strain readings obtained from extensiometers that are sensitive to cross strains, or from true-strain readings obtained from extensiometers that for practical purposes are insensitive to cross strain.

## Wind Tunnels & Laboratories

**Work Begins on Wind Tunnel to Test Rocket Models at Supersonic Speeds.** *North American Skywriter*, Vol. 7, No. 41, October 10, 1947, pp. 1, 2, illus.

North American Aviation, Inc., has begun the construction of a supersonic intermittent wind tunnel having a test section 16 by 16 in. and a variable diffuser that will develop speeds up to 3,400 m.p.h. Motive power is provided by a vacuum chamber that supplies a maximum flow of 65 cu.ft. of air per min. for test periods of 15 sec. The installation is designed to operate 7 times an hour. Measurements will be made with a six-component balance.

**Stratosphere Chamber (Vickers-Armstrong, Ltd.)** *The Engineer*, Vol. 184, No. 4783, September 26, 1947, 1947, pp. 296–298, illus.

Keyed ground plan, elevation, and tabulated specifications of the chamber under construction by Vickers-Armstrong, Ltd. The test section is a cylinder 25 ft. in diameter and 50 ft. long. It can simulate conditions of temperature and pressure found at any latitude and at any altitude up to 70,000 ft.

**Aircraft-Testing Chamber (Vickers-Armstrong, Ltd.)** *Engineering*, Vol. 164, No. 4259, September 12, 1947, pp. 257, 258, illus.

**Climatic Hangar for All-Weather Testing.** *Product Engineering*, Vol. 18, No. 10, October, 1947, pp. 147–149, illus.

The climatic hangar at the Air Proving Ground Command Headquarters, Eglin Field, Fla., for testing aircraft and equipment under service conditions and for determining the effects of weather on personnel and on the efficiency of maintenance operations.

**Wind Tunnel Power.** *Diesel Power and Diesel Transportation*, Vol. 25, No. 10, October, 1947, pp. 42–43, 74, 85, illus. Description of the electric power station at the N.A.C.A. Langley Memorial Laboratory, Langley Field, Va.

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# Books

**Flight Engineering and Cruise Control.** Harris G. Moe. New York, John Wiley and Sons, Inc., 1947. 209 pp., illus., diagrs. $4.00.

Prepared with the particular object of providing pilots with the background of technical knowledge essential to a true understanding of airplane and engine operation, "Flight Engineering and Cruise Control" is an outstanding book that will be welcomed by commercial, military, and private pilots. The book should be particularly helpful to those preparing to take the C.A.A. examinations for flight engineers. The aeronautical engineer will also find it convenient for reference. It fills the need for a not overtechnical presentation of this basically complex subject. Some of the topics covered have heretofore been associated solely with the work and training of aerodynamicists and design engineers. While it is not light reading, the large amount of valuable information that it contains is set forth in a clear manner. The author formerly was Division Engineer of Consolidated Vultee's Consairway Division and also has pilot training and experience flying as a test engineer.

Subjects discussed include the theory of flight and elementary aerodynamics; altimeters and altitude determination; air speed, stalling speed, and operation of flaps; power in relation to airplane performance, fuel consumption, and associated variables; supercharged engines; the theory, operation, and design of various types of propellers; basic cruising techniques; flight planning and control; weight and balance, including aircraft loading; take-off and landing techniques and theories; the fundamentals of jet propulsion; and specifications and performance characteristics of commercial transport and private airplanes.

**Air Passenger Traffic.** William L. Grossman. Brooklyn, N.Y., Remsen Press Division, Chemical Publishing Co., Inc., 1947. 205 pp., illus. $3.00.

The author of this book, who is Assistant Professor of Public Utilities and Transportation, School of Commerce, Accounts, and Finance, New York University, has succeeded in presenting the basic principles of air passenger traffic in such a clear manner that even new, inexperienced employees in an air-line traffic department should be able to acquire from it the background of knowledge necessary for the efficient performance of their duties. The book should be a valuable aid to those planning a career in the air-line traffic field. Domestic transportation has been chosen for primary emphasis in the chapters on traffic procedures because more people are engaged in it. Due attention, however, is given to international traffic procedures. Because of the scanty source material on some topics, the author has based his statements, in such cases, on information obtained from direct observation and from consultation with those actively engaged in the particular work.

For information on I.A.S. Library Service Facilities, see page 33

The meaning and significance of the basic units of measurement used in air passenger traffic statistics are explained. Consideration is given to the analysis of air traffic volume, basic methods of estimating future domestic air traffic, point-to-point traffic, and the volume of overseas traffic. In the chapter on nonrevenue passengers, information is given about the nature and volume of this type of traffic and the legal restrictions. There are chapters on who travels by air, domestic and international passenger tariffs, joint and special fares, the universal air transportation plan, and scheduling methods and procedure. Included in the chapter on reservations are particulars about space control and the recording of information about reservations. The chapter on ticketing gives details about the parts of the ticket, interline and online tickets, and refunds. The final chapter is devoted to passenger correspondence, the passenger relations department, and communications from passengers.

**Modern Air Transport.** F. S. Stuart and H. C. Biard. London, John Long, Ltd., 1947. 186 pp., illus. 18s.

The possibilities and realities of modern air transport are discussed in simple language by the authors, who have been collaborating for some 15 years on investigating the subject. F. S. Stuart is a London and New York correspondent and a writer of books on flying. H. C. Biard, who has worked for many years as a test pilot, is a Schneider Trophy winner and former holder of the world's air speed record. All the important phases of air transport are discussed in considerable detail. Consideration first is given to air transport requirements, existing airports, the case for seadromes, safety in air traffic, and transport aircraft of different countries. There are discussions on transatlantic air routes, empire and foreign trunk routes, the internal networks of the United States, England, and Europe, and British Commonwealth air-line companies. Some of the other subjects discussed include operational costs and problems, air transport expansion, private and club flying, gliders and sailplanes, racing, airships, the fighting air forces, high routes of the future, and changes in aircraft design.

# Other Books Received

**AIR POWER**

**Elements of American Air Power.** Washington, D.C., Aircraft Industries Association, 1947. 249 pp., figs., tables. A reproduction of 24 papers submitted by member companies of the Aircraft Industries Association to the President's Air Policy Commission during hearings held in September and October, 1947. They are concerned with the relationship of the aircraft industry to national security, the future of guided missiles, the role of air transportation, air freight, the future of the helicopter, personal planes, industrial mobilization and planning, and other pertinent subjects.

**AIR TRANSPORT**

**The Co-Ordination of Road, Rail, and Air Services, Hyderbad State, India.** E. W. Slaughter. London, Institute of Transport, 1947. 32 pp., illus., folding charts.

**The Story of Air Transport.** Jim Ray. Philadelphia, The John C. Winston Co., 1947. 104 pp., illus. $2.50. A brief, popular history of commercial air transport in the United States.

**AIRPORTS**

**Airport Reference, Seventh Annual Edition, 1947–1948.** Los Angeles, Occidental Publishing Co., 1947. 50 pp., illus. $1.00. Additional and revised material is included in this latest edition, which incorporates a directory of equipment manufacturers, a classified directory of airport products, reviews of periodical literature and books pertaining to airports, a list of catalogs and folders on airport equipment, and storage classifications of aircraft.

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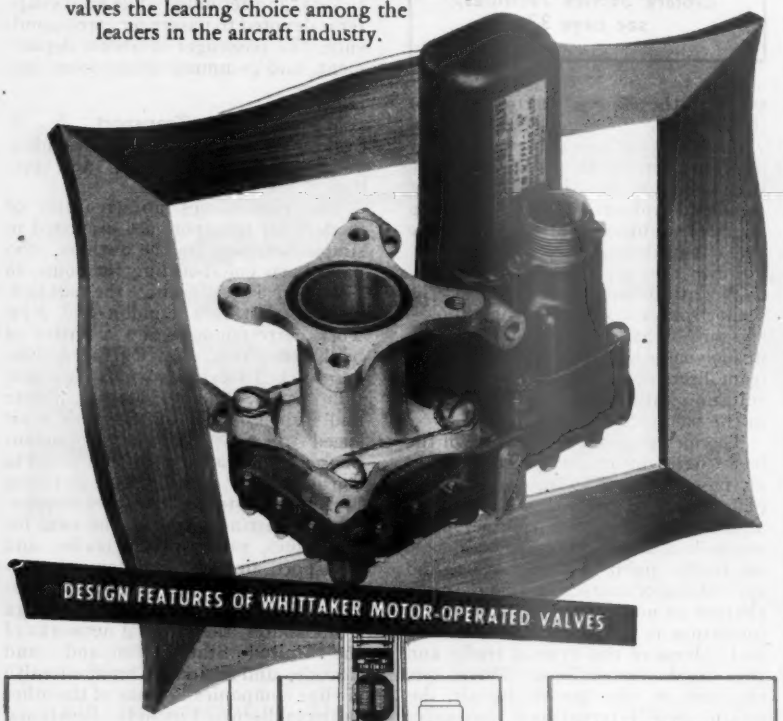

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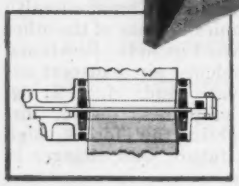

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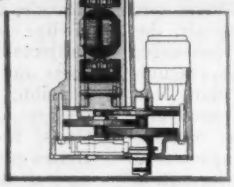

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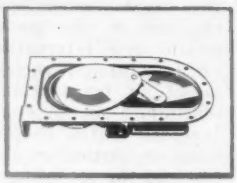

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**Airports and the U.S.; An Economic Study.** Washington, National Aeronautic Assn., 1946. 85 pp. An extensive economic study of airport systems of today, with the many factors and problems connected with their development. Considerations affecting future development also are analyzed.

## ATOMIC ENERGY

**Bombs at Bikini; The Official Report of Operation Crossroads.** W. A. Shurcliff. New York, William H. Wise and Co., Inc., 1947. 212 pp., illus. $3.50. The text of the official, non-technical, public report on Test A, the explosion in the air, and Test B, the underwater explosion. The author is historian of Joint Task Force One, which conducted the tests. Appendixes include organizational charts; lists of personnel, observers, and support and target vessels; preliminary statements by the Evaluation Board and Evaluation Commission on Tests A, B, and C (cancelled), chronology of the five atomic bomb detonations; and indexes of subjects and names.

**Atomic Bomb Explosions; Effects on an American City.** R. E. Lapp. Washington, War Department General Staff, Research and Development Division, 1947. 15 pp., diagrs. In this booklet a physicist presents a realistic picture of the damage that a typical American city might suffer were an atomic bomb to be detonated over it.

## ELECTRONICS

**Survey of Existing Information and Data on Radio Noise Over the Frequency Range 1–30 Mc/s.** H. A. Thomas and R. E. Burgess. Gt. Brit., Department of Scientific and Industrial Research, Radio Research Special Report No. 15. London, H.M. Stationery Office; New York, British Information Services, 1947. 126 pp., figs., diagrs. $1.00. A critical survey of available published literature on all types of radio noise affecting radio reception over the frequency range from 1 to 30 mc. Included is a summary of all the useful measurements of atmospheric noise which are available to the National Physical Laboratory. There are sections devoted to receiver, thermal, atmospheric, man-made, and cosmic noise; the influence of noise on reception; and the measurement of noise. A bibliography of 188 references is included.

**High Frequency Measuring Techniques Using Higher Transmission Lines.** E. N. Phillips, W. G. Sterns, and N. J. Gamara. New York, John F. Rider Publisher, Inc., 1947. 58 pp., diagrs., figs. $1.50. A booklet describing techniques used for determining the wave length, impedance, velocity of propagation, electrical length, and attenuation in four-terminal networks by means of a shielded transmission line with a continuous slot in its axial length, a measuring scale along this length, and an index to indicate the position of a probe that explores the field between the conductors. The discussion has reference to the frequency spectrum above 100 mc.

**Instructions for the Use of Basic Radio Propagation Predictions.** (U.S., National Bureau of Standards, Circular No. 465, August 27, 1947.) Washington, U.S. Govt. Printing Office, 1947. 41 pp., figs. $0.25. A manual prepared to explain how calculations of maximum usable frequencies and optimum working frequencies may be made for skywave transmission over any path for any time of day by the use of the contour charts of frequency issued monthly by the U.S. Department of Commerce. The methods described, although detailed, are relatively simple.

## FIRE PROTECTION

**Suggested Standard Operating Procedures, Aircraft Rescue and Fire Fighting.** Boston, National Fire Protection Assn., 1947. 15 pp. $0.25. These suggested procedures are intended for airports having a full-time crash-rescue and fire-fighting organization. They are broken down according to the conditions likable to be encountered, as follows: Condition A—on the aerodrome, on land; Condition B—off the aerodrome, on land; Condition C—on the aerodrome, in the

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water. Additional standard operating procedures cover local public fire department cooperation, aircraft crew training and discipline, and ambulance medical service. Appendixes contain a statement regarding the responsibility of the aerodrome manager, the minimum standards for aircraft rescue and fire-fighting equipment, and a glossary of definitions.

### GASES

**The Mathematical Theory of Non-Uniform Gases; An Account of the Kinetic Theory of Viscosity, Thermal Conduction, and Diffusion in Gases.** Sydney Chapman and T. G. Cowling. Cambridge, At the University Press; New York, The Macmillan Co., 1939. 404 pp., figs. $8.00.

### HISTORY

**They Tamed the Sky; The Triumph of American Aviation.** Douglas J. Ingells. New York, D. Appleton-Century Co., Inc., 1947. 268 pp., illus. $3.50. A collection of historical sketches of the activities and accomplishments of the men who have advanced aviation to its present state of development. The book contains nontechnical descriptions of outstanding inventions and developments in aviation and tells how they were advanced and perfected. Much of the information was obtained through a search of the files at Wright Field, and the author has endeavored to make the volume historically accurate. There is a foreword by James H. Doolittle.

**Man's Fight to Fly.** John P. V. Heinmuller. Reprint Ed. New York, Aero Print Co., Somerset Publishing Co., 1945. 370 pp., illus. $1.49.

### MAINTENANCE

**Airframe Servicing Handbook.** J. K. Jones. London, Blackie and Son, Ltd., 1947. 126 pp., diagrs. 8*s*. 6*d*. There is a surprising amount of concise information about the servicing of air frames packed into the 126 pages of this little handbook, which is one of Blackie's "Technique" Series. The author's aim has been to provide a guide suitable for both beginners and experienced workers in the field. To supply the former with a background of general knowledge, chapters are included on metallurgy, the heat-treatment of metals, corrosion and its prevention, and the theory of flight. The first two chapters are devoted to a discussion of the various types of tools and their use. Instructions then are given for marking out, bending, and forming sheet metal. Other chapters discuss screw threads, locking devices, rivets and riveting, the use and repair of fabric, the construction of the air frame, repairs to the air-frame structure, aircraft control surfaces, shock absorbers, brakes, and hydraulic components, aircraft surface finishes, and the inspection of the air frame. The text is clarified by the inclusion of a great many drawings and diagrams. The volume appears to fulfill all the requirements for a handy and complete guide to the servicing of air frames.

### MATHEMATICS

**A Handbook on Curves and Their Properties.** Robert C. Yates. Ann Arbor, Mich., J. W. Edwards, 1947. 245 pp., figs. $3.25. Only plane curves are treated. There are 18 sections on curve analysis and curve systems and 26 sections on individual curves. All the sections are arranged in one alphabet by the names of the curves or topics. The manner of presentation is more or less uniform for each section. The sections on individual curves start out with a short history of the curve, which is followed by description, equations, metrical properties, general information on construction and related curves, and a short list of references to books and papers. The sections on analysis and systems treat of such topics as curvature, evolutes, intrinsic equations, involutes, pedal equations, and sketching; they also contain short lists of references. Explanations of the derivations of some of the properties are omitted when they are not of general interest, or when they can be readily supplied by the reader. There is a list of the notations used and a detailed, 6-page subject index.

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**Differential and Integral Calculus Vols. I (New Revised Ed.), II.** R. Courant. Translated by E. J. McShane. New York, Interscience Publishers, Inc., 1947. 616, 682 pp., figs. $6.00, $7.50. The first volume of this English translation of a German text on the differential and integral calculus has been revised for the second time. The examples have been improved and rearranged, many new examples have been added at the back of the book, and there is some additional material on differential equations. A feature of the text is the simultaneous treatment of differential and integral calculus, which is a departure from the tradition of teaching these branches of the subject separately. Volume I contains the material for a course in elementary calculus, although there is much that should be omitted from a first course. It deals mainly with functions of one variable. The author's aim has been to develop the most important facts in the differential and integral calculus so that the reader will be equipped to study the more advanced branches of the subject. Volume II is devoted to more advanced phases—that is, the functions of several variables and some other extensions of the calculus.

**Tables of Spherical Bessel Functions. Vols. I, II.** Mathematical Tables Project, National Bureau of Standards. New York, Columbia University Press, 1947. 379, 332 pp. $7.50 per Vol. I. The main table in this volume contains the functions of orders $\nu = (n + 1/2)$, where $n = 0(1)\ 13$ and $x = 0(0.01)\ 10(0.1)\ 25$. The majority of the entries are given to eight significant figures for $x < 10$ and to seven significant figures for $x > 10$, except near the zeros of the functions. II. The major part of this volume is devoted to tables of spherical Bessel functions $\sqrt{x}\ J_\nu(x)$, for $\nu$ ranging from 29/2 to 61/2. This set of tables complements those presented in Vol. 1 for $\nu$ ranging from 1/2 to 27/2.


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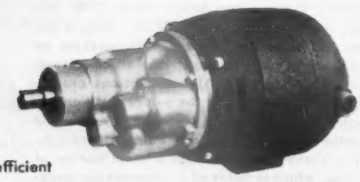

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**Tables of the Bessel Functions of the First Kind of Orders Zero and One, Two, and Three.** (Harvard University, Computation Laboratory, Annals, Vols. 3, 4.) Cambridge, Mass., Harvard University Press, 1947. 580, 580 pp. $10.00 per Vol. These tables were calculated by the automatic sequence controlled calculator. The calculation is carried to 18 decimal places, with a wide range of argument and order, fine argument interval, and a high degree of accuracy that has heretofore been unattainable. The tables allow the user to find functions quickly and with minimum effort. An introduction describes the computational techniques employed and the methods of interpolating within the tables.

**Table of the Bessel Functions $J_0(Z)$ and $J_1(Z)$ for Complex Arguments.** Prepared by the Mathematical Tables Project, National Bureau of Standards. 2nd Ed. New York, Columbia University Press, 1947. 407 pp. $7.50. Contains also a table of "Five-Point Lagrangian Interpolation Coefficients." The tabulated material is the same as in the first edition, but certain errors in the labeling of the graphs have been corrected, and some minor revisions in the introductory section have been made.

**Applications of the Absolute Differential Calculus.** A. J. McConnell. (London, 1936.) London, Blackie and Son, Ltd., 1946. 318 pp., figs. 26*s*.

**The Theory of Matrices.** C. C. MacDuffee. Corrected Reprint of First Edition. (Ergebnisse der Mathematik und Ihrer Grenzgebiete, 2. Band.) New York, Chelsea Publishing Co., 1946. 110 pp. $2.50.

**Practical Descriptive Geometry.** S. E. Rusinoff. Chicago, American Technical Society, 1947. 259 pp., figs., tables. $3.50. The application of descriptive geometry in the automotive, machine-tool, aviation, and steel industries, and related fields. Emphasis is on actual practice. Engineering drawing and the basic principles of drafting and geometry are reviewed as an introduction to the subject.

**Examples in Engineering Mathematics.** Book II—For Students Taking Second-Year Senior Courses for the National Certificates in Mechanical, Electrical, and Aeronautical Engineering. I. R. Vesselo and S. H. Glenister. London, George G. Harrap and Co., Ltd., 1947. 87 pp., figs. 3*s*. 6*d*.

## MECHANICS

**Mechanik. Band II.—Dynamik der Starren Körper. (Mechanics. Vol. 2—Dynamics of Rigid Bodies.)** Ernst Meissner and Hans Ziegler. Basel, Verlag Birkhäuser, 1947. 291 pp., figs. Cloth, Sw. fr. 28.50; full leather, Sw. fr. 32.50. The second in a series of elementary textbooks on mechanics. The German lecture courses on which they are based were intended to supply a solid foundation in basic mechanics to the technology and science students of the Eidgenössische Technische Hochschule in Zurich. The material handled in this volume falls into three divisions: the dynamics of rigid bodies considered as unique centers of mass, the kinematics of rigid bodies, and the kinetics of rigid bodies. The subject of kinematics is given a limited treatment so as to serve as an introduction to kinetics. The new concepts introduced in this work are lucidly explained and their definition is repeated frequently to assist the beginning student. The last five sections of the book take up the theory and character of gyroscopic motion and are introduced by a section entitled "Kinetostatics," which develops the theory of stability of bodies in motion.

## METEOROLOGY

**An Analysis and Solution of Certain Forecasting Problems at La Guardia.** R. D. Roche and P. W. Funke. (A.T.A. Prize Award in Meteorology.) Atlanta, Ga., Meteorological Department, Eastern Air Lines, Inc., 1946. 122 pp., figs., maps. (Reproduced from typewritten copy.) A comprehensive analysis and study of weather conditions at La Guardia Airport, based on data collected over a period of 6 years. Sections are devoted to topography, oceanography, statistical

analysis, winter prewarm frontal weather, and air mass fog. A bibliography of 12 references and a rapid reference chart for forecasting are included.

### PLYWOOD

**Plywood; What It Is—What It Does.** Louis H. Meyer. New York, McGraw-Hill Book Co., Inc., 1947. 250 pp., illus., diagrs. $3.50. This manual has been written with the specific object of providing industrial designers and engineers with a complete picture of when, where, and how to use plywood and kindred laminates in their projects. The information presented will also be useful to woodworkers, purchasing agents, and students desiring to acquire a thorough knowledge of the subject. The book supplies detailed particulars about the composition, structure, and mechanical characteristics of plywood and other laminates. The various types of plywood are discussed and illustrated, with emphasis placed on their applicability, superiority, limitations, and manufacturing processes. Included are data on wood species, as well as a comprehensive analysis of various bonding agents used in the manufacture of plywood and allied products. The author treats of general and unique plywood characteristics, plywood applications and techniques, plywood marketing, and the features of softwood, hardwood, and specialized products. Additional information is presented in an appendix, and there is a glossary of plywood terms and a bibliography.

### PRODUCTION METHODS

**Shot Peening.** 3rd Ed. Mishawaka, Ind., American Wheelabrator and Equipment Corp., 1947. 181 pp., illus., diagrs. $1.50. A detailed explanation of the shot-peening process for engineers and production men. The book is divided into four parts. Part I discusses the applications and advantages of shot peening, the relative merits of airless blasting versus air blasting, the shot used for peening, and shot-peening equipment and its use in production. Parts II–IV deal with the strengthening of metal parts by shot peening, improving the strength of machine parts, and the metallurgical advantages of shot peening. Included are a bibliography, lists of references, and a glossary of technical terms.

**A Bibliography on Die Casting, 1910–1946.** Cleveland, Technical Publishing Co., 1947. 74 pp. $7.50. An extensive bibliography compiled by the editors of the magazine *Die Castings*. The literature is classified as alloys, applications, uses, design, finishing, general, machines, processes, properties, books and pamphlets, and index to *Die Castings* magazine.

### REFERENCE BOOKS

**United States Government Manual, 1947.** 2nd Ed., Revised through June 1, 1947. Washington, U.S. Govt. Printing Office, 1947. 713 pp. $1.00.

### STATISTICS

**Selected Techniques of Statistical Analysis for Scientific and Industrial Research and Production and Management Engineering.** Statistical Research Group, Columbia University, Applied Mathematics Panel, Office of Scientific Research and Development. Edited by Churchill Eisenhart, Millard W. Hastay, and W. Allen Wallis. New York, McGraw-Hill Book Company, Inc., 1947. 473 pp., figs., tables. $6.00. A thorough discussion of those problems that arise in the planning, analyzing, and interpreting of quantitative data, prepared especially for scientists, engineers, managers, and statisticians. Techniques applicable to the various problems are explained in terms of both general principles and specific procedures. Each problem is discussed from the angles of statistical approach and applicable theory. Detailed workable computational procedures are given, together with formulas, tables, and charts to illustrate the interpretation of results. The volume is divided into three parts, which are devoted to industrial statistics, planning experiments, and techniques and tables. The book has not been written with the object of presenting much new statistical theory, but several topics have been given more thorough treatment than has previously been available.

### SOUND

**Sound: A Physical Text-Book.** E. C. Richardson. 4th Ed. London, Edward Arnold and Co.; New York, Longmans, Green and Co., 1947. 344 pp., diagrs. $5.00. The fourth edition of this standard text for students and technicians has been brought up to date by incorporating the results of recent research in the revisions and additions. There are chapters on the velocity of sound, vibrating systems, longitudinal and torsional vibrations in solids, and transverse vibrations of strings and rods. Other chapters deal with membranes and plates; vortex formation and jet tones; columns of air, including Prandtl's theories of viscous fluids; the analysis of sound; acoustic impedance; supersonics; subjective sound; and the technical aspects of sound. Sufficient mathematical theory is introduced to enable the student to follow the physical concepts. Knowledge of college physics and mathematics, including elementary calculus, is prerequisite. There are about 500 footnote references and an eight-page index of subjects and authors cited in the text. The references include all complete papers published during the last 20 years, except those that are of little physical interest or are duplications of other works. References published before 1907 are given only for the authors cited in the text, since Winkelmann's *Handbuch der Physik* provides ample coverage of work before 1907.

### STRUCTURES

**The Experimental Study of Structures.** A. J. S. Pippard. London, Edward Arnold and Co.; New York, Longmans, Green and Co., 1947. 114 pp., illus., diagrs. $2.50. This text was written with the purpose of encouraging the more general use of small-scale experimental work in teaching the theory of structures. It is based on a short course of lectures and demonstrations given by the author, who is Professor of Civil Engineering in the University of London at Imperial College. He has devoted considerable time to the development of a laboratory equipped with inexpensive small-scale models that permit essential theorems to be illustrated and verified experimentally. A number of experimental sheets illustrate the possibilities of the apparatus described. Chapters are devoted to theorems and methods, direct experimental methods, experimental application of Clerk Maxwell's theorem, strain-energy and distribution methods, the experimental study of arches, and experiments with sand. Some miscellaneous equipment is dealt with in the appendix. There is a list of 17 reference books and articles, and a subject index.

**Symposium on Testing of Parts and Assemblies.** Sponsored Jointly by A.S.T.M. and Society for Experimental Stress Analysis. Presented at the Forty-Ninth Annual Meeting, A.S.T.M., Buffalo, June 26, 1946. (Technical Publication No. 72.) Philadelphia, American Society for Testing Materials, 1947. 86 pp., illus., figs. $1.50. Most of the papers should be of particular interest to aeronautical engineers dealing with stress problems and the testing of fatigue strength. The papers are entitled: The Fatigue Strength of Lap Joints in Some Magnesium Sheet Alloys, Fatigue Characteristic of Magnesium Castings, Endurance—A Criterion of Design, Pneumatic Fatigue Machines, Automotive Rear Axles and Means of Improving Their Fatigue Resistance, and Stress Concentration and the Fatigue Strength of Engine Components.

### WORLD WAR I

**The Air Weapon, 1914–1916.** (Winged Mars, Vol. 2.) John R. Cuneo. Harrisburg, Pa., Military Service Publishing Co., 1947. 503 pp., maps. $5.00. The functional value of the air weapon in the first 2 and 1/3 years of World War I is examined in this second volume of the Winged Mars series, which is devoted to a study of the true role of the air weapon in warfare. The information regarding aerial warfare as carried out by Germany, France, and England during this period has been drawn from many sources, and the author has endeavored to base his conclusions on the weight of the most reliable evidence. He reviews the activities of the air forces in their first major war and examines particularly the relation of the air weapon to the defensive system which succeeded the headlong offensive of World War I. The subject is treated in sections devoted to tactical operations over land, tactical operations over sea, and strategic air operations. There are over 77 pages of notes indicating some of the sources of the text and also a list of almost 300 references. While the casual reader may object to so detailed a treatment of the subject, the author holds that this was necessary to dispel the fantastic tales that at present pass for air "history."

### WORLD WAR II

**U.S. Naval Logistics in the Second World War.** Duncan S. Ballantine. Princeton, N. J., Princeton University Press, 1947. 308 pp. $3.75. A study of naval and logistic planning and administration during the last war. The author, who is a historian and was a naval officer during the war, served for a year in the South Pacific, where he witnessed the construction of advance bases and other logistic activity. He also served for two years in the historical section of the Chief of Naval Operations. To quote his own words, the book deals with "that limbo between factory and beachhead in which economic and military considerations are inextricably woven together."

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## *Changes of Address*

**Since the Post Office Department does not as a rule forward magazines to forwarding addresses, it is important that the Institute be notified of changes in address 30 days in advance of publishing date to ensure receipt of every issue of the *Journal* and *Review*.**

**Notices should be sent directly to the Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.**

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## Sections and Branches

(*Continued from page 13*)

S. Barnaby, U.S.N. (ret.), featured William Littlewood, Vice-President, American Airlines, on "Current Air Transport Problems."

▸ **Ground Facilities Prewar**—Littlewood pointed out that although plane size, passenger and cargo traffic have doubled, ground facilities have remained at the prewar standard.

Coupling the factor of growth with an overoptimism immediately following the war, air-line management was faced with a public expecting all the technical tools developed for war purposes to be at the disposal of the air lines.

Littlewood expressed concern over the effect of new devices and developments (while still in research stage) in halting progress in basic plans of airplane construction.

By way of illustration, he showed how a complete and sound plan for increasing ground facilities in its final stage can be halted by a spectacular flight of a rotary-wing aircraft. City officials not conversant with all phases of air transportation immediately envision a local taxi service to and from town. As a result, new roads connecting the town with other airport facilities are postponed for further discussions.

Immediate and further study of ground facilities must be made to keep pace with air-line growth and development, Mr. Littlewood said.

▸ **Speeds for Air Lines**—In commenting on speeds for air lines, two curves for the past 15 years of military and civilian aviation were studied. Increase in speed and miles per hour per year were plotted. The average increase in speed was shown to be about 15 m.p.h. Air-line transport speed increases, as indicated by the curves, were approximately half the military aircraft speed increases.

According to Littlewood, it is the belief of air-line men that 300 m.p.h. will be the accepted speed rate for air-line travel. Supersonic speeds will have two limiting factors, human limitations and comfort, he said.

▸ **Altitude Limit at 20,000 Ft.**—The efficient altitude for transports, according to Littlewood, seems to level off at 20,000 ft., and airplane size seems limited to 50–60 seats in the future. These limitations, he added, probably will be in effect for some time, because of passenger comfort and economical operation.

In explaining traffic organization of air lines, Littlewood presented, for illustration, the problem inherent in a big city airport serviced by several air lines. Aircraft of diverse types and capabilities and schedules utilize the same airport.

To solve the resulting traffic problem, American Airlines has introduced control timing, which permits 4-min. landings. The best previous times were 7-min. landings that resulted in "stacking."

A block system is being introduced by Railway Signal Systems and General Electric Co. which utilizes lights similar to the railroad system for both aircraft and ground facilities.

▸ **Suggests Control System**—Laying great stress on the importance of traffic organization, Littlewood advocated a traffic-control system that would contain the following features to aid the pilot:

- Pictorial reproduction of conditions of airport and vicinity. This need not be an exact representation, but carry enough of the essentials for the pilot to project and visualize his "bearings."
- The pictorial reproduction must be safe and not deceptive in any way.
- There must be adequate monitoring to check the pilot's "picture."
- Emergency aid must be available in case of failure of the pictorial instrument.
- Adequate approach lights must be provided at the airport.
- Fog dissipation equipment must be available.

Following the talk, a motion picture of American Airline travel in Mexico was shown.

## San Francisco Section

R. T. Nilsen, *Secretary*

Results of election of Section officers for 1948 were: Chairman, Smith J. de France; Vice-Chairman, Prof. Elliot G. Reid; Treasurer, Don O. Horning; Secretary, R. T. Nilsen; and Representative to I.A.S. National Nominating Committee, J. R. MacGregor.

Two papers on the Thermal Anti-Icing Program were read at the November 6 meeting: "General Results of N.A.C.A. Flight Research in Natural Icing Conditions" and "Debut of Thermal Ice Protection in Commercial Aviation."

▸ **Theoretical Approach**—The theoretical approach was presented by Norman Bergrun, formerly with the National Advisory Committee for Aeronautics as Aeronautical Research Engineer, and presently a student at Stanford University, in his paper on "General Results."

W. C. Shaw, Air Conditioning Engineer, United Air Lines, presented the practical application. Both papers indicated thorough knowledge of thermal anti-icing, and the scope of the operations showed that another hazard to commercial and military flying had been effectively handled.

There were also indications in Shaw's presentation that considerable work needed to be done along the line of ice-formation detection.

Films were shown of the actual deicing and anti-icing operations as carried out by N.A.C.A. and U.A.L.

▸ **Light-Plane Device**—J. E. Lindburg of Pan American Airways and Lindburg Instrument Company presented his companies' answer to the need for a light-plane ice-detection device. This device can be installed in most aircraft engine carburetors in place of the usual primer unit, Lindburg said. It consists of an air gap of fixed potential, high-frequency discharge current from the ignition system picked up by a coil wrapped round a spark-plug lead, which is normally grounded.

Ice formation in the air gap changes the potential and causes the discharge to make a neon tube on the pilot's dashboard light up in warning.

## Seattle Section

Gene B. Williams, *Secretary*

Results of the election of officers were announced at the November 7 meeting of the Section in the Boeing Aircraft Cafeteria. New officers elected were: Jere T. Farrah, Chairman; Victor M. Ganzer, Vice-Chairman; V. L. Blumenthal (a new member), Secretary; and C. P. Steele, Treasurer.

J. E. Steiner, Preliminary Design Engineer, Boeing Aircraft Company, presented a paper, "Commercial Aircraft Design to Comply with Civil Aeronautics Regulations."

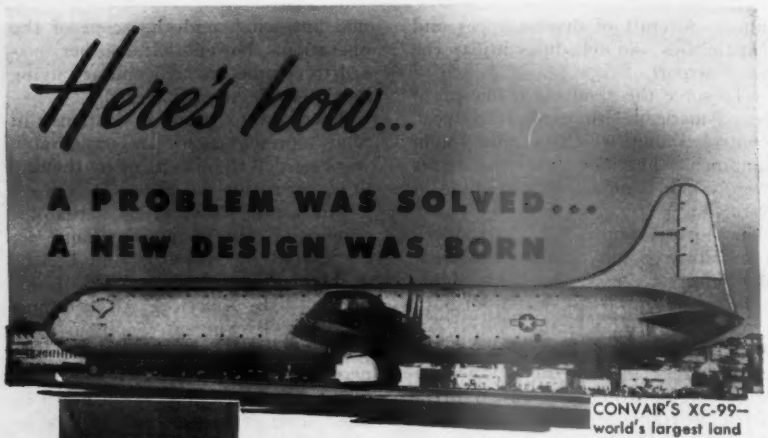
▸ **Limitations Imposed by C.A.A.**—Steiner discussed the various limitations to commercial aircraft design imposed by C.A.A. Regulations. The paper demonstrated the use of certain parameters in selecting basic features of an aircraft so that the final article would meet C.A.A. requirements.

▸ **Dryden Speaks**—Dr. Hugh L. Dryden, Director of Aeronautical Research, N.A.C.A., spoke briefly regarding the proposed plan for consolidation of research agencies in this country. Dr. Dryden pointed out that research must be adequately financed but unfettered in order to obtain optimum results.

## Toronto Section

Carl V. Lindow, *Secretary*

Meeting in the University of Toronto November 19, members heard

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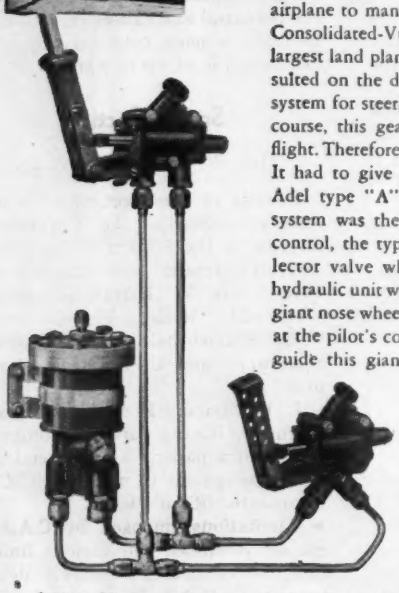

Adel's type "A" ISOdraulic remote control is a manually-operated hydraulic system. Basically, it consists of a closed circuit of tubing containing a hydraulic fluid. At both ends of this tubing are pistons, so designed that the pressure applied to the fluid by one piston causes the other piston to be moved. A compensator automatically corrects variations in fluid volume caused by atmospheric temperature changes.

The Adel type "A" is a self-contained hydraulic system. It is adaptable to numerous remote control applications, such as aircraft engine controls, propeller feathering, cowl flap regulation, radiator air control, ventilator control and many others.

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J. T. Dyment, Director of Engineering, Trans Canada Airlines, on "Air-line Design Requirements for Regularity."

Dyment stressed the importance of regularity to economical air-line operation. T.C.A., he said, maintains a comprehensive record of the causes of all delays which are reviewed in great detail.

▶ **Delays Attributed to Design**—It was pointed out in his paper that a large percentage of delays can be attributed to airplane design and power-plant installation. In particular, there is a great deal of room for improvement in the loading and unloading facilities and the accessibility of accessories.

Dyment went on to outline a hypothetical plane that would meet the air-lines' design requirements for regularity. This airplane as described, developed into a double-decker with a 13-ft. diameter fuselage and weighing about 125,000 lbs. A smaller transport, according to Dyment, cannot accommodate the passengers, cargo, and accessories in the manner desired.

## Carnegie Institute of Technology

Two meetings, chairmanned by Bernard Bace, November 4 and 11, were confined to Branch business. Date for the "get-acquainted" stag party was set for November 19.

## University of Detroit

At the November 6 meeting, presided over by Russell J. Cornair, Chairman, Col. C. V. Burnett, Manager, Detroit City Airport, gave a talk centering on two main topics: airport management and the light-plane industry.

In his talk, Colonel Burnett stressed the following points:

(1) To increase public interest and sales, the light-plane industry needs a flivver plane similar to the Ford of a few decades ago.

(2) Air service from downtown Detroit to Cleveland would be available within the next 2 years, he predicted.

A special meeting was called by Chairman Cornair November 19 to discuss the possibility of the Branch participating in the Engineering Show to be held at the University in the near future. It was unanimously voted to participate. A committee was appointed to make the necessary arrangements.

At the close of the business meeting, a film of the University of Detroit-St. Mary's football game was shown.

## Georgia School of Technology

Fifteen students applied for membership at the November 11 meeting, Chairman Edmund E. Novotny presiding. A film on Ground Controlled Approach concluded the meeting.

## University of Illinois

The history of rocket propulsion was traced in a talk by Prof. M. Z. Krzywoblocki, Department of Aeronautical Engineering, given at the October 29 meeting attended by 103 members. Chairman was Robert S. Chubb.

Professor Krzywoblocki traced rocket propulsion development from its original use as a weapon in 1899 to present-day experiments being conducted in Australia.

## Illinois Institute of Technology

The Branch's new Faculty Adviser, Dr. H. V. Hawkins, was introduced at the meeting of November 6, replacing Prof. E. I. Fiesenheiser, to whom the Branch expressed its appreciation for his able and willing assistance while he was its Faculty Adviser.

At the November 13 meeting, the technical session included the showing of the film, *Planes Without Pilots*, with Dr. Hawkins explaining technical details. The picture showed the complete electronic control of the Bell P-59 jet plane through all flight maneuvers, take-off, and landing, in addition to the relay of flight-test data to the ground during flight.

New student officers elected were: Chairman, Kenneth F. Gerleman; Vice-Chairman, Marvin M. Brown; Secretary-Treasurer, Eugene P. Virtue.

Norman F. Eslinger, former Secretary-Treasurer, presided at the two meetings.

## University of Kansas

Two films furnished by the Air Force, *Raids and Invasion of Pantelleria* and an Army staff film, constituted the first part of the November 12 meeting. William F. Armstrong, Jr., Chairman, presided.

Member John Fowler gave a short talk on the advantages of being an Institute member.

Extensive plans were made for exhibits to be sponsored by the Aeronautical Engineering Department at the Engineering Exposition at the University. A committee was appointed to handle details.

## Louisiana State University

With Chairman Arthur W. Cruikshank, Jr., presiding, ten new members were welcomed into the Branch at the October 28 meeting. The Faculty Adviser, Frank T. Carroll, Jr., gave a talk on "The Advantages of Becoming a Student Member of the Institute of the Aeronautical Sciences."

The November 12 meeting featured the film, *Operation of P-47 Type Aircraft in Northern Italy*, which was made by one of the Branch members.

## University of Minnesota

At the Branch's November 4 meeting, Lt. Col. A. A. Arnhym, Chief, Air Documents Division, Air Materiel Command, gave a lecture and a film-showing on "German Guided Missile Development" before a capacity audience of 400.

Colonel Arnhym described methods and difficulties involved in obtaining information and documents pertaining to German developments in the field of guided missiles in the past 12 years.

Following his introductory remarks, he showed a motion picture composed of captured German films depicting the results of German research. Colonel Arnhym provided a running commentary describing the scenes shown.

Chairman Louis F. Heilig then called a business meeting. He urged all aeronautical engineering students present who were not members to join the organization.

A committee was appointed by the Chairman to plan for the annual Aero Ball to be given in February, 1948.

## Mississippi State College

"What to Expect in the Aviation Industry" was the subject of a talk by Joseph Meigher, Instructor, Aeronautical Engineering Department, at the November 13 meeting, Chairman Robert E. Sizemore presiding.

A Membership Committee, to work out plans for increasing Branch membership, was appointed. Committee Chairman Jerome Rossoff and committee members Anne Luckett, William Grafton, and W. W. Woodward were selected.

## University of Notre Dame

Following a business meeting November 13, at which Vice-Chairman Walter M. Marut reported on arrangements for a tour of Bendix Aviation Corporation, two films were shown: *A Thunderbolt Is Made* and *Flight Aerobatics of a Thunderbolt*, both by Republic Aviation Corporation.

At the November 25 meeting, in the absence of Chairman Joseph M. O'Hara, the Vice-Chairman presided. A report on the November 25 tour of Bendix Aviation was made, and arrangements were made for the same tour on December 2 for those unable to attend the first.

Secretary John E. Cronin announced that the Disabled American Veterans Club had been engaged for the dinner on December 15.

At the conclusion of the business session, two films, *Ground Handling of the P-47* by Republic Aviation, and *Ramrod to Emden*, a U.S.A.F. picture, were shown.

## University of Oklahoma

A joint meeting with Tau Omega fraternity was held November 11, presided over by Owen G. Morris, Vice-Chairman.

Following the showing of a film, *Aircraft Carburetors*, Laverne A. Comp, Professor of Aeronautical Engineering, University of Oklahoma, presented a talk on the Annual Summer Meeting of the Institute in Los Angeles last August.

## Parks College of Aeronautical Technology

The Branch held an informal meeting November 13, Richard A. Dean, Chairman, presiding.

Three films were shown: *A Thunderbolt Is Made, Planes Without Pilots* and *Flight Log*.

## The Pennsylvania State College

At a short business meeting November 20, plans for a "get-acquainted" party were discussed, new file application cards were distributed, and new members were admitted.

An N.A.C.A. film, *For Better Aircraft in the World of Tomorrow*, was shown. The picture showed some test arrangements at Langley Field, including free-flight wind tunnel and 1/2-mile water tunnel for testing flying-boat hulls.

Chairman William W. Sunday presided.

## Rensselaer Polytechnic Institute

A general election held November 6 resulted as follows: Chairman, Robert E. Bower; 1st Assistant Chairman, Sidney T. Swallow; 2nd Assistant, John E. Kuhl; Secretary-Treasurer, Andrew Sabatiuk; 1st Assistant Secretary-Treasurer, George M. Low; 2nd Assistant, James G. Davis. Faculty Adviser is A. J. Fairbanks.

Because the election had been deferred to a late date, it was decided that the elected officers would continue in office through the spring term, except where graduations occurred. To meet vacancies as they occurred, two assistants were elected to each office.

The motion pictures, *Jet Propulsion*, by General Electric, and *The Phantom* (*Navy XFD-1*) *Airplane* were shown.

Chairman Bower opened the November 20 meeting by introducing Professor Fairbanks, who in turn introduced A. C. Aument, Service Engineer, Trans World Airline, the principal speaker.

Speaking on "Airline Engineering Problems," Aument briefly outlined operations of T.W.A.'s domestic and foreign services. Company organization was detailed as to its component parts—flight crews, maintenance, service, and engineering departments. Engineering problems involving design changes and service reworks on the Lockheed Constellation were discussed extensively.

A short film, *Constellation Elevator Booster Unit Servicing*, concluded the meeting.

## Stewart Technical

Following a talk by the Faculty Sponsor, Mr. Di Giovanni, on the "Importance of I.A.S. and Election of Officers," at the meeting of November 14, new officers were elected to the posts vacated by graduating members.

New officers were: Joseph Szejko, 1st Vice-Chairman; William Blau, 2nd Vice-Chairman; Joseph Provey, Secretary; and Fred Busch, Treasurer.

## Syracuse University

The second meeting of the semester was held November 14 with Chairman Elton Bischoff presiding.

Following a business session, Douglas T. Lewis, a student member, gave a talk on an article obtained from *Aviation Week*. In it he described a radically new helicopter design by Seidler.

The General Electric film, *Jet Propulsion*, was shown.

## Texas A. & M.

Under Chairman William D. Menefee, a business meeting was held November 11.

A general discussion of the program for future meetings was included. R. M. Pinkerton, Faculty Sponsor, announced that E. W. Norris, Vice-President in Charge of Engineering, Luscombe Airplane Corporation, would talk before the Branch following the Christmas holidays.

## University of Toronto

Holding a meeting November 10, Branch members heard Ronald Keith, Editor, *Canadian Aviation* magazine, speak on "Private Flying in Canada."

Mr. Keith outlined the government's view on the topic and amendments required in the Air Regulations to keep pace with private flying. He also discussed the expansion and improvement of airfields and facilities necessary for the promotion of private flying. He pointed out some features desirable in future light planes.

In the business session that preceded the talk, Chairman C. F. Matthews presented the constitution of the Branch to the members. The Rules and By-Laws were accepted as read.

On November 18, a Sikorsky S-51 'copter gave a demonstration in Varsity Stadium for the benefit of students in the Aeronautical Engineering course. The problems of rotary-wing aircraft were explained briefly, and the control and rotor mechanisms were described.

The flight demonstration included hovering, backward and lateral flight, and rapid climb from a dead start.

## Virginia Polytechnic Institute

Meeting November 11, Chairman James L. Saffell introduced the principal speaker, Arthur E. Rowland, Faculty Adviser, who gave a talk on "The Douglas Skystreak," based on a report recently given out by E. H. Heinemann, Chief Engineer, Douglas Aircraft Company, Inc., El Segundo Plant.

Three films were shown: *D-Day Minus One*, *Reconnaissance Pilot*, and *The Story of the Helicopter*.

On November 25 the films *Target Tokyo* and *Victory in the Air* were shown.

## Tri-State College

Two films were shown at the November 12 meeting: *Report on Jet Propulsion*, and *The Phantom*. Clifton A. Smith, Chairman, presided.

The group working on the extreme spanwise airfoil curvature research reported that a model is under construction.

Work on the three projects suggested by the Project Committee (see AERONAUTICAL ENGINEERING REVIEW, December, 1947) was reported at the November 19 meeting as follows:

(1) Extreme spanwise curvature airfoil—test-model construction well under way;

(2) "Butterfly" (Beech Bonanza type) tail assembly—detailed plans for test model drawn up; requests made for available printed matter on the subject;

(3) Helicopter research—still in calculation stage.

The Liaison Committee reported that the Tri-State College Rocket Society was working out plans for thrust-measuring tests.

In conclusion, K. J. Miller, student member, gave a factual report on aviation accidents.

## Wayne University

"Jets Vs. Reciprocating Engines" was the topic of a talk by Thomas N. Kelly, Research Engineer, Continental Aviation & Engineering, a Past-Chairman of the Detroit Section of I.A.S., at the October 24 meeting.

Mr. Kelly presented some cost comparisons on jet and reciprocating engines, pointing out that the high costs of jets is a great factor in preventing their use in commercial and private planes.

In a business session following the talk, a new Vice-Chairman and a new Secretary were elected to fill vacancies caused by graduating officers. The new officers elected were, respectively, Archie H. Laird and Margaret I Evans.

The film, *Target for Tonight*, concluded the meeting.

## University of Wichita

A short business meeting preceded a talk by Daniel K. Bird, student member, on "Air Transportation." Robert W. Burnham, Chairman, presided.

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*New Date of*

*Flight Propulsion Meeting*

*Cleveland—Hotel Carter—March 19, 1948*

# Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

## Elected to MEMBER Grade

**Braasch, Herman Lynn,** B.S., Structures Engineer, Ryan Aeronautical Co.

**Carter, John Henry,** M.A.-M.E. in Administration, Lt. Col., Asst. Chief—Guided Missiles Section, Engineering Div., U.S. Air Forces (Wright Field).

**Hudson, Thomas E.,** B.S. in M.E., Mechanical Engineer, Naval Ordnance Test Station (Pasadena, Calif.).

**Lemcoe, M. M.,** B.S. in C.E., Sr. Research Engineer, Flutter Unit, McDonnell Aircraft Corp.

**Pelissier, Jean Pierre,** Chef de la section aérodynamique, Société Nationale des Constructions Aéronautiques du Nord (France).

**Small, John,** M.S. and Ae.E., Aerodynamicist, Northrop Aircraft, Inc.

**Spreuer, William Eash,** B.S. in E.E., Flight Test Analysis Engineer, Lockheed Aircraft Corp.

**Stever, Horton Guyford,** Ph.D. (Physics), Asst. Professor, Aero. Engineering Dept., M.I.T.

## Transferred to MEMBER Grade

**Adams, Richard Edward,** B.S. in M.E., Sr. Aerodynamicist, NEPA Div., Fairchild Engine & Airplane Corp.

**de Graffenried, Albert Lawrence,** B.Ae.E., Instructor, Aero. Engineering Dept., Rensselaer Polytechnic Institute.

**Helfman, Sidney,** B.Ae.E., Sr. Aerodynamicist, Stability Group, Guided Missiles Section, Republic Aviation Corp.

**King, Douglas Andrew,** B.Ae.E., Aero. Engineer, P-3, Tank No. 2 Section, Langley Mem. Aero. Lab., N.A.C.A.

**Lehmkuhl, Joel Carl,** Ae.E., Chief of Special Measurements Sub-Unit of Structures Branch, War Dept., Air Corps Hqs. AMC (Wright Field).

**Lettvin, Norman,** Ll.B.

**Lichten, Robert Lyon,** S.B. in Ae.E., Chief Engineer, Transcendental Aircraft Corp.

**Ramamritham, Subramania,** M.Ae.E., Technical Observer, Pan American World Airways.

**Rasumoff, Abner,** B.Ae.E. Project Stress Analyst, Kellett Aircraft Corp.

**Schwarzbach, Jerome Mitchell,** B.S. in Ae.E., Flight Test Analyst, Pilotless Plane Div., Fairchild Engine & Airplane Corp.

## Elected to Associate Member Grade

**Fitch, Walter Miller,** conducting series of experimental flight tests on pilotless aircraft—self employed.

**French, Charles Towner,** Liaison Engineer—Washington Representative, Fairchild Camera & Instrument Corp.

**Kimball, Albert Boggess,** M.A. (Math.), Special Representative, Aircraft Industry, International Business Machines Corp.

**Portteus, Paul Harold,** Vice-President and General Manager, Stratos Corp.

**Witten, Jack Francis,** Chief Inspector, Naval Air Station, U.S. Navy.

## Elected to Technical Member Grade

**Governale, Rose Marie,** B.A., Jr. Engineer, Fairchild Engine & Airplane Corp.

**Heberding, Harold Edward,** Engineer, Equipment & Controls Group, Airplane Div., Curtiss-Wright Corp.

**Richter, Donald Marvin,** Instrumentation Engineer, North American Aviation, Inc.

**Steere, Samuel Adams, Jr.,** B.S., Major, Project Engineer, Rocket Unit, P.P. Lab., Engineering Hqs. AMC, U.S. Air Forces (Wright Field).

**Wilburn, Hiram Sam,** Instructor, Aircraft & Engine Refresher Course, The Aeronautical University, Inc.

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Transfers from Student to Technical Member will be published in the February issue of the REVIEW.

## Necrology

### Alfred J. Marchev

Alfred J. Marchev, 51, President of Aircraft Screw Products Company, Inc., of Long Island City, N.Y., died at his home in Garden City, Long Island, on November 28, 1947. Mr. Marchev, who was an Associate Fellow of the Institute, had been President of Republic Aviation Corporation during World War II. He retired as Chairman of the Board in May to become President of Aircraft Screw Products Company.

He was born in Zurich, Switzerland, where he was educated as a mechanical engineer, and he achieved prominence as an inventor, with more than 500 patents made out in his name. After coming to this country, Mr. Marchev occupied many important engineering and management posts with Thomas Morse Aircraft Corporation, Ithaca Gun Works, and Western Electric Company.

In 1926, he founded the Temple Radio Corporation, serving as its President. Later he became Chief Engineer and Works Manager for Ditto, Inc., subsequently holding similar positions with the Signode Steel Strapping Company.

In 1942, Alfred Marchev joined Republic Aviation as Assistant to the President, and was named President the following year.

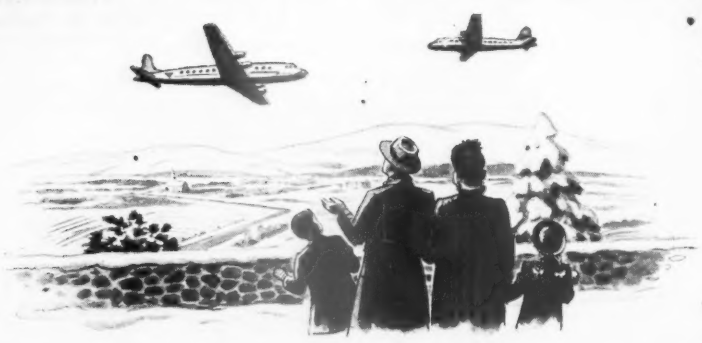
A former Chairman of the Executive Committee of the Aircraft Manufacturers' Council, Eastern Region, Mr. Marchev also was a former member of the Board of Governors of the Aircraft Industries Association of America.

Alfred Marchev.

### Harold Henry Sweberg

Harold H. Sweberg, Research Aerodynamicist at Langley Field, Va., N.A.C.A., died September 7, 1947. A graduate of Louisiana State University, he had been connected with the Langley Field full-scale wind tunnel for the past 6 or 7 years. His specialty was stability and control, and he was responsible for all stability and control works of the full-scale research division of N.A.C.A.'s Langley Memorial Aeronautical Laboratory.

# Sentinels of Peace



"A just and lasting peace among ourselves and with all nations" . . . that was the goal which Abraham Lincoln set for his countrymen eighty-two years ago. It is the goal toward which we are striving today—more earnestly than ever before. Though the ideal may seem far short of attainment, lasting peace throughout the world represents the hope and aspiration of men of good will everywhere. Winging through the skies on friendly missions, America's planes are reminders of the might which must ever be the bulwark of permanent peace. Our air fleet has helped to make this country strong; if we are to continue invincible, we must maintain it. Only a powerful America can remain a peaceful America.

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# Personnel Opportunities

**This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.**

## WANTED

**Aerodynamicists**—With experience in stability and control work and flight testing. Positions require good academic background and sound knowledge of dynamics and applied mathematics. Advanced degree desirable. Must have training, experience, and ability to assume major responsibility in both the theoretical and experimental flight-test phases of major programs of aircraft flight dynamics, and be familiar with standard methods of flight-data reduction. Write Employment Office, Cornell Aeronautical Laboratory, 4455 Genesee St., Buffalo 21, N.Y.

**Research Engineers**—Openings for experienced aerodynamicists, thermodynamicists, and electronic engineers with opportunity for research in supersonics. Openings also for engineers with jet-engine-test experience. Please include complete résumé of experience and education in reply. Write to: Consolidated Vultee Aircraft Corporation, Lone Star Laboratory, Daingerfield, Tex.

**Aeronautical Engineers**—Aircraft research engineers and scientists needed for work on task research programs. Projects under way require men with the ability to apply the theories of dynamics, structures, aerodynamics, thermodynamics, and aircraft design to the solution of varied applied research problems on airplanes, helicopters, and guided missiles. Educational background and knowledge should approximate that required for a Masters Degree in Engineering or Physics. Experience desirable but not so essential as a good basic training and a well-developed scientific curiosity. Cornell Aeronautical Laboratory, Employment Office, 4455 Genesee St., Buffalo 21, N.Y.

**Assistant Professor or Instructor**—Staff member to teach aircraft structural analysis and applied mechanics; also to set up complete structural testing laboratory. Must be familiar with aircraft structural practices in order to work with local aircraft industry. Previous teaching experience desired but not essential. Please give brief sketch of education, experience, and personal qualifications. Address, Kenneth Razak, Head of Aeronautical Engineering Department, University of Wichita, Wichita, Kan.

**Mechanical Engineer**—An excellent opportunity is open for a mechanical engineer with experience in gas turbines. You will have the best of laboratory equipment to work with and an opportunity for freedom of expression and development of ideas with the leading manufacturer of automatic control equipment. Write today giving full particulars of your training and experience: J. A. Johnson, Minneapolis-Honeywell Regulator Company, 4th Ave. and 28th St., Minneapolis 8, Minn.

**Flutter Engineer**—Aeronautical Engineering graduate with several years of experience in flutter and vibration problems for work on advanced military aircraft. Address reply to Engineering Personnel Office, North American Aviation, Inc., Municipal Airport, Los Angeles, Calif.

**Aerodynamicists and Aeronautical Engineers**—Positions available for highly qualified technical personnel with good theoretical or experimental background to engage in development and model test work in stability, control, high-speed, and supersonic aerodynamics. Projects include new models of piloted and pilotless aircraft, new wind tunnels and associated equipment, and advanced testing techniques. Salary in accordance with qualifications and Civil Service regulations. In reply, please give brief summary of personal qualifications, education, and experience. Address—Director, David Taylor Model Basin, Washington 7, D.C.

**Instructor or Professor**—To take charge of, and to teach, subjects in the aeronautical option of mechanical engineering department. Subjects consist of aerodynamics, airplane design, internal combustion engines, etc. Complete laboratory equipment, including B-17 Flying Fortress, P-51 Fighter, Link trainers, and wind tunnel. Rank and salary dependent on qualifications. Teaching experience not necessary. Applicants should write to the Department of Mechanical Engineering, Montana State College, Bozeman, Mont.

**Jet Power Plant Specialists, Theoretical Aerodynamicists**—Experienced men needed for development work on subsonic and supersonic guided missiles. Write to or apply at Marquardt Aircraft Company, 4221 So. Lincoln Blvd., Venice, Calif.

**Engineers**—Long-term helicopter development program for Army Air Forces requires additional engineering personnel: (1) stress engineers with 4 or more years' experience, (2) senior layout men, and (3) mechanical draftsmen. Apply in writing to Manager, Helicopter Division, Kellett Aircraft Corporation, North Wales, Pa.

**823. Pilots**—Experienced helicopter test pilots wanted. Must have a minimum of 100 hours of helicopter flying time. Engineering background desirable. Preferably service trained. East Coast concern.

**812. Engineer—Production**—Trained in designing for low-cost production. Must be a graduate engineer and have aircraft experience. Progressive and expanding concern in metropolitan Philadelphia area. Send complete résumé.

**811. Engineer, Mechanical**—Experienced in the designing of precision transmission systems. Aircraft experience preferred. Progressive and expanding concern in metropolitan Philadelphia area. Send complete résumé.

**810. Engineer**—Qualified aeronautical or mechanical engineer with a minimum of 4 years' experience in the helicopter field. Progressive and expanding concern in metropolitan Philadelphia area. Send complete résumé.

**804. Theoretical Aerodynamicist**—A Ph.D. in Aeronautical Engineering, Mathematics, or Physics is needed at a large Mid-Western university as an associate professor or professor in the Department of Aeronautical Engineering to teach advanced theoretical courses in aerodynamics. The duties would include advanced undergraduate and graduate teaching through the Ph.D. level and the direction of theses. Opportunities for research, research consultation and industrial consultation exist.

**800. Assistant Professor—Dynamics**—A leading state university with recognized department of aeronautical engineering and both undergraduate and graduate divisions needs permanent staff member to give courses in vibrations, flutter, and the dynamics of the airplane and to direct graduate research in this field. Position is permanent. Rank—Assistant Professor or higher, Salary attractive. M.S. degree and experience in aircraft industry necessary. Position to start February 1, 1948.

**799. Associate or Professor**—Middle West state university with strong graduate division in aeronautical engineering needs additional new permanent staff member to develop and give instruction in the general field of supersonic aerodynamics and to direct basic and applied research in this field. Rank—Associate Professor or higher. Salary attractive. Starting date February, 1948, but can wait until September, 1948, if necessary.

**798. Airplane Flight-Test Engineers**—Aerodynamicists with experience in stability and control work and flight testing. Position requires a good academic background and sound knowledge of dynamics and applied mathematics. Advanced degree desirable. Must have training, experience, and ability to assume major responsibility in both the theoretical and experimental flight-test phases of major programs of aircraft flight dynamics and be familiar with standard methods of flight-test data reduction.

**796. Chief Stressman**—With C.A.A. requirements experience, and one or two assistants, to take charge new project. Reply stating full particulars of past experience, salary required, and when free to take up a new position.

**The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.**

## AVAILABLE

**827. Mechanical or Aeronautical Engineer**—M.S. Desires position that combines engineering or research with administrative duties; East Coast, preferably New England. Last 4 years as aerodynamicist, designer, and development engineer on guided missiles projects; previous experience includes 8 years of extensive research, consulting work, and teaching at leading Eastern engineering school. Details and references upon request.

**826. Aeronautical Engineer**—M.S. in Ae.E. Over 4 years' experience with major aircraft companies, mainly in flutter and vibration work.

**825. Quality Control Executive**—Experienced in organizing and administering mechanical inspection and maintenance of aircraft and motor vehicles, recruiting and job evaluation for over 500 civilian office and technical personnel. Qualified airplane pilot—5,873 military hours, all types. West Point graduate, 1923. Aeronautical engineer.

**824. Associate Professor**—B.S., M.S., receives Dr. Eng. (Aero.) in June, 1948. Broad experience includes: 5 years' graduate work and structural research; 4½ years in industry as stress analyst and structural test engineer; 4 years as assistant professor of aeronautical en-

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**822. Chief Designer**—M.E. Age 43, married, Latvian nationality. Four years' industrial and engine design and 16 years' aeronautical engineering, 6 years of which as responsible chief designer at the aviation division of the largest firm in the Baltic States. Project author and supervisor of design, construction, and flight tests of several light high-speed private and military aircraft types, including a light fighter. One of the private planes successful in competitions in Europe. Two years in the German aircraft industry (component design for jet planes). Familiar with all preliminary analysis, materials and processes. Specialist in improved wood and mixed constructions. Speaks and writes well Latvian, German, and Russian; English fair. Descriptions and photos of the realized projects and references will be sent upon request as proof of ability to create successful types. At present in Europe; desires position in a small U.S. or Canadian firm, where the opportunity exists to expand along with the company. Commencing salary secondary if opportunity is right and if help to leave Europe will be given.

**820. Technical and Promotional Writer**—Will help sell product, proposal, or idea by writing promotional letters, ads, booklets, technical, and publicity articles, reports. Writes technical descriptions that a layman can easily follow. Experienced in industry; able to see things from prospect's point of view, pick out points that appeal, and present them in manner that invites action. Detroit area.

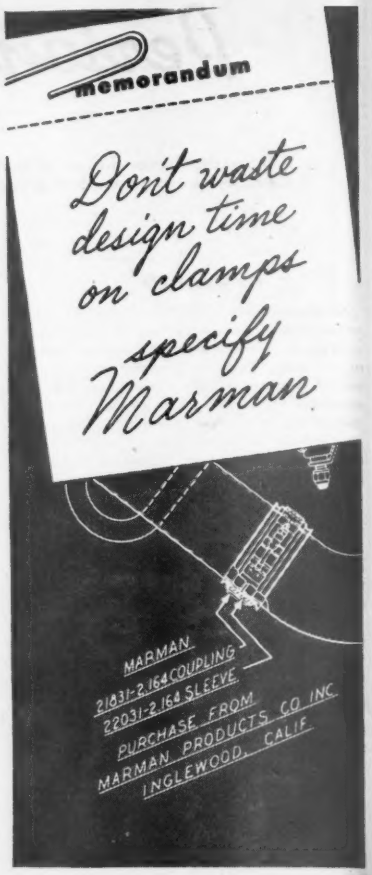
**819. Aero-Mechanical Engineer**—Graduate of State University of Iowa, 1941. Experienced in high-powered reciprocating engine fuel systems and power controls, light aircraft power plants and fixed equipment, research and experimental work in general aircraft problems. Desires to locate in the East. Prefers assignment on jet or rocket engines or general flight research and experimental problems. Capable of handling most engineering phases from original design and layout through customer liaison and project evaluation.

**818. Aeronautical Engineer**—B.S. in Ae.E., 1936. Eleven years' progressive service and experience in aerodynamics, aircraft structural design and analysis, performance, and static testing. Five years as chief of structures and testing. Thoroughly experienced in military and civil design requirements. Sound theoretical and practical understanding of all aircraft design problems on small or large aircraft. Particular capabilities exist in supervision of engineering and laboratory personnel. Possesses organizational ability. Desires to obtain a position requiring initiative and responsibility in which experience and background will be of value.

**817. Sales Representative**—Engineering background; extensive sales experience in United States, Europe, Africa, and South America. Four languages; single; will locate anywhere.

**816. Aeronautical Engineer**—B.Ae.E. Rensselaer Polytechnic Institute; age 29, married. Four and one-half years' experience in the Engineering Division, Air Materiel Command, Wright Field, engaged in flutter research, ground vibration testing and evaluation, wind-tunnel testing, and development of vibration-measuring equipment. Two years' experience in the U.S. Navy at Bureau of Aeronautics, Washington, D.C., in the Aviation Design Research Branch, engaged in the study of flight paths and other special problems related to guided missiles. Desires position in research or development.

**815. Aeronautical Engineer**—B.S. in Ae.E., Iowa State College. Age 22. Single. Two years'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**814. Aeronautical Engineer**—Age 36; married. Two and one-half years with major aircraft manufacturers as a specialist in weights and balance, technical writing, technical reports, and specifications writing. Able to handle and familiar with machine-shop practice. Holds a valid A. & E. license from the C.A.A. Has had approximately 12 years' all-around experience on transport and private type aircraft as a technician. Would like position as technical reports writer, liaison, and/or maintenance engineer.

**813. Flight Engineer**—Age 29. Seven years' air-line experience. Five years' flying with approximately 4,000 hours on B-314, PB-2Y, C-87, C-54, DC-4, L-49, L-749. A. & E license, Flight Engineer's license, B.M.E. degree. Interested in settling on West Coast with air line that has an expanding flight engineering department.

**809. Aeronautical Engineer**—Age 31; married. Graduate engineer in South America; B.S. Ae.E. in this country; also maintenance engineer in U.S.A.F. technical school. Ten years' experience in aviation maintenance, overhaul, and purchasing. Purchasing engineer for a South American air force and air line for 2 years. At present working own export business. Desires position with manufacturer, air line, or aviation maintenance company, either in this country or in South America. Will furnish details and references on request.

**808. Design Engineer**—Graduate, pilot. Extensive private airplane design experience directing project, structures, flight-test groups. Desires position utilizing background.

**807. Project Engineer**—Ph.D. Extensive experience in industrial research in supersonic aerodynamics and guided missiles. Fifteen years' university teaching and research. Interested in developing fuel and propulsion research program, either university or industrial. Presently employed by West Coast airplane company. Available immediately.

**805. Engineer**—Englishman; age 29; married. Just resident in Canada. Seven years' administration, air-line maintenance, overhaul, planning, technical authorship (one published). Good contacts in British civil aviation. Will consider any progressive post.

**803. Aeronautical Engineer**—B.S. in Aeronautical Engineering. Age 25, married. Two and one-half years' experience as structural engineer in personal aircraft field. Thoroughly familiar with C.A.A. procedures under both C.A.R. 04 and 03. Also has good practical background in radio, radar, and electronics. Holds Commercial Radiotelephone Operator's License. Desires position associated with design and development of aircraft electronic equipment or in personal aircraft field. Prefers West Coast or east of Mississippi.

**802. Technical Translations**—From English to French, or conversely, by French aeronautical engineer. At present technical translator with an official aviation organization. Twenty-five years in the aeronautical field and well known for his research and realizations in France and in U.S.A.

**801. Law-Engineering**—B.Ae.E. degree and completing L.L.B. degree. Six years' experience in testing of experimental aircraft and missiles, static, dynamic, and flight tests, for a Government agency. One and one-half years' part-time patent law experience. Former officer of local I.A.S. Section. Good appearance, personality, and excellent in personnel relations. Desires position combining engineering and law with a law firm, engineering company, aero-insurance company, etc., in contract, patent, or similar work. Los Angeles, New York, or Philadelphia areas preferred.

**797. Dynamics, Vibration, and Flutter Specialist**—Thirteen years' academic and industrial experience in this field. Holding considerable unpublicized knowledge for employer desiring high caliber services. Supervisory rank not mandatory, but equivalent salary. Please describe opening.

**795. Aeronautical Engineer-Pilot**—B.S. in Ae.E. from University of Michigan. Age 32; married. Two years in present position designing major units for leading aircraft manufacturer. Familiar with Army, Navy, and C.A.A. requirements. Naval aviator for 7 years. Two thousand four hundred hours' flight time. Two years' experience supervising 25 mechanics and maintenance of 20 dive bombers aboard an aircraft carrier. Seven months as an executive officer. At present, commanding officer of an air group and fighter squadron in the Organized Naval Reserve, with former rank of Lieutenant Commander. Holds C.A.A. commercial single and multiengined land and instrument ratings. Desires position combining flying and engineering or flying and administrative-executive work.

**794. Engineer**—M.E., M.M.E., Ph.D.; age 42. Associate Professor teaching applied mechanics and fluid mechanics. Some industrial research experience in stress analysis and mechanical design. Broad general background in mechanical and aeronautical engineering. Desires position in industrial research and development or as head of department teaching applied mechanics.

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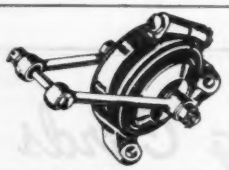

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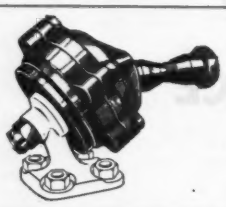

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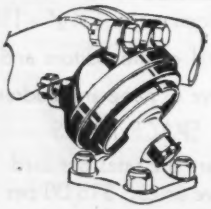

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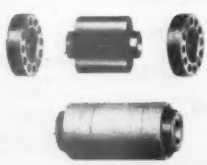

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